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WHAT'S INSIDE YOUR MICROWAVE OVEN

SPECIAL FEATURE ON PCB TECHNOLOGY

CHECKING OUT THE LATEST SONY VIDEO-8 CAMCORDERS

PROJECTS TO BUILD: LOW COST 50MHz COUNTER, RF PROBE, SIMPLE POWER TRANSISTOR TESTER, I/O CARD FOR PC-AT'S

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Coming next month in Electronics Australia

Stereoscopic 3D-TV

How far away is 3D-TV? Will it be worth waiting for? Will the final system still need special glasses? Read the answers to these and other intriguing questions, in our feature story next month.

Low cost stereo amplifier

Here's a good medium-powered stereo amp design, for those who don't want to pay the earth. It gives you all of the basic facilities, and is especially easy to build.

Enhanced colour graphics card

Build your own multimode enhanced colour graphics adaptor card for PC-ATs and compatible computers. It provides CGA mode, high definition CGA (640 x 400), Hercules (720 x 328) and MDA mode (720 x 350), with flashless screen updates. Very easy to build, and much cheaper than comparable commercial cards.

Volume 50, No.5

Electronics Australia

May 1988

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE – ESTABLISHED IN 1922

What's inside the latest microwave ovens

The humble microwave oven is probably the most of ten used electronic appliance in modern homes. Here's a rundown on how they work and what's inside the latest models. See page 20.

Projects to build

Four great construction projects for you again this month: a low cost 50MHz digital frequency counter, a simple tester for power transistors (to check them properly), an RF detector probe for our bench amplifier/signal tracer, and a "2 serial ports plus printer port" I/O card for PC-AT computers and compatibles.

PCB Technology feature

This month's special feature on PCB technology includes a very interesting story on advances in high-speed drilling machines. See page 96.

ON THE COVER

We're not sure if Panasonic's Jon Fitch really did cook that roast himself using the firm's new NN6557 microwave oven, but it certainly makes for a non-sexist cover! See our story on page 20. (Picture courtesy National Panasonic Australia)

Features

Entertainment Electronics

Projects and Technical

News and Comment

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Letters to the editor

NiCads in practice

I have been following with interest the debates over NiCad batteries in your *Forum* column. I appreciate the subject is officially closed, but as we get our magazines in New Zealand approximately two months late, I hope you will see fit to publish my letter.

It seems your two main protagonists have dug themselves into opposite and extreme corners. My company sells a range of dictation and portable audio equipment, and services a variety of battery powered equipment including off-road cars and radio controlled models. We generally recommend the use of NiCad batteries for the following reasons:

1. In the case of dictation equipment, provided the unit has been left on charge over night, the user KNOWS without any shadow of a doubt that he has battery power to last him right through the day. In the busy business situation this is essential. Also an increasing number of students are using portable dictation equipment to record their lectures and the same comments apply. Naturally, they don't want to be scrambling for fresh batteries halfway through a lecture.

2. In high usage units such as radio controlled cars, the cost of dry batteries (usually on the parents' pockets) is astronomical. A number of user-induced faults have occurred through mixing partly discharged batteries with fully charged or different duty units.

In general terms it is not so much the absolute savings associated with NiCad batteries which are important, as that the unit will work as expected when expected, without having to find replacement batteries. So far, we have had no calls for replacement batteries and particularly in dictation equipment (using 2×AA cells). These units have been in use every working day for over three years.

While I appreciate Mr Allison's bringing to our attention the negative aspects of using NiCads, in the real world of relying on battery-powered equipment they are essential, cost and possibly limited life not withstanding.

The only place I have observed any real problems with NiCad batteries is in video equipment and portable electric drills, which use high current temperature limited chargers (i.e., where a thermal switch in the battery pack stops an otherwise very high charge after approximately one hour). Under these conditions all the problems of memory charge, cell reversal and limited life do occur. However if the same batteries are trickle charged, as some videos offer as an alternative to the fast charge, then these problems do not appear.

I trust these observations from actual experience are of some interest.

B. Burdekin, Mgr
Sigtec Systems Ltd,
Christchurch, NZ.

Electronic typewriters

There is one piece of electronic equipment which is rarely mentioned in your pages. It is the thermal dot matrix electronic typewriter, (henceforth, simply called an electronic typewriter). Several years ago, Mr Neville Williams favourably reviewed the Brother EP 44; since then I can recall no further mention of these light, quiet and versatile devices.

Interest in the subject was rekindled by my experiences while investigating the possibility of replacing my Brother EP 41 with the latest EP 150 model.

The manager of the first shop seemed to take my enquiry as a personal insult. Electronic typewriters were said to be troublesome and flimsy, and the cassette ribbons capable of producing only a fraction of the characters claimed.

Mine has never failed me, but this information merely placed me into the category of a one-off freak. Management of this shop had been warned by head office interstate of customers who were complaining that the EP 150

DROP US A LINE!

Are you concerned about something to do with electronics, and believe that others ought to know about it? If so, feel free to put pen to paper, or fingers to keyboard, and send us a Letter to the Editor. If it's clearly expressed and on a topic of interest, chances are we'll publish it – but we do reserve the right to edit those that are overlong, or potentially libellous.

character lift off correction would not work on thermal paper and that sheets of paper could not be fitted lengthwise into the machine.

The brochure is clear that standard paper is used and is explicit on the paper capacity of 10.2 inches. Therefore, any after-sales problems are the result of a poorly briefed salesperson and not the typewriter.

The next store was a Brother dealer. Here, with great courtesy, I was told that the electronic typewriter did not meet the standards of their customers and that I should enquire at a department store. However, I was given the only brochure they had; these pamphlets being in the "Golden Fleece" category.

The questions arise: am I a second class citizen for being totally satisfied with an electronic typewriter? Are these machines held in contempt by mainstream dealers? Is it the no-man's land between the daisy wheel and the word processor?

I suspect that old hands are suspicious of the electronic component and reluctant to concede that so much can be done on a machine so small, so quiet, so easy to carry and so simple to use. I remain unaffected by their prejudice and continue to have full confidence in the technology.

Your views and those of your readers will be most welcome.

Ian S. Sells,
Tea Tree Gully, SA.

Comment: I must confess I haven't any direct knowledge of electronic typewriters myself, Ian. But it sounds as if they may be an innocent casualty in the war of the word processors? What do our readers think?

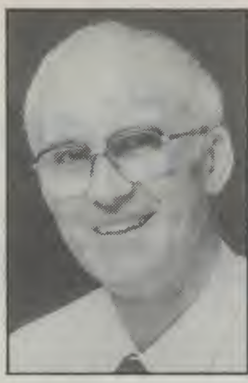
A bouquet

Congratulations for a really great magazine. I am fourteen years old, and ever since starting in the wonderful field of electronics I have purchased *Electronics Australia*. It has kept me informed and up to date with all the latest news in electronics, and also published very interesting projects, which are useful and fun to build.

I am considering electronics as a career although our school (Girton College) does not have a large course, on the subject. And if I choose Electronics as a career, I am sure that *Electronics Australia* will keep me informed.

Joe Ciancio,
Bendigo, Vic.

Comment: Thanks for the compliments, Joe, We hope you continue to find the magazine of value.



Editorial Viewpoint

Made in Australia: does anyone really care?

We Aussies are great at mouthing platitudes and setting up all kinds of impressive looking organisations, at great expense, to show how committed we are to supporting local manufacturing industry and the products it produces. But that's about all it really is: a show. Particularly when it comes to our electronics manufacturing industry.

In last November's issue I drew attention to an incredible anomaly in our customs tariffs, where a great deal of complete equipment from "developing countries" attracts only a tiny 2% duty, while many components needed by local manufacturers attract anything between 15% and 30%. This is obviously having the exact *opposite* of the effect that customs tariffs are supposed to achieve – apart from a short-term boost to public coffers.

I was amazed when I learned of this situation, which is so inimical to our supposed national goals of supporting local manufacturing. That's why I gave it so much emphasis. But how much response do you think there's been? Zilch.

Now I've become aware of another example, on a much more local level. As a Bicentenary project, the Greater Taree City Council on the North Coast of NSW has been building a regional entertainment centre. The funding has included nearly $600,000 in grants from the Australian Bicentennial Authority and the NSW Bicentennial Council.

As it happens, local audio amplifier designer Peter Stein's company ME Sound has its design and manufacturing centre factory in the same area. Not surprisingly when the time came for the centre's amplifier system to be purchased, Peter tried to get his firm's products considered. But he was turned down flat. Eventually the Council advised it had resolved to use a certain brand of Japanese equipment 'because this is compatible with equipment already owned by the Taree Arts Council'.

So much for giving locally designed and manufactured products a fair go! It's one thing to decide against a local firm's products after careful consideration of technical or cost/benefit factors, but refusing to even allow them to tender and be considered in the first place is quite another. And the excuse about supposed 'compatibility' sounds pretty unconvincing – they're talking about audio amplifiers after all, not computers.

When I was growing up, my mum had a saying 'Actions speak louder than words.' It's still just as true today. If we can't give Australian manufacturers and their products a fair go even in 1988, our actions (or inactions) make it quite clear that we don't really give a damn about them, despite all our rhetoric.

No wonder Peter Stein and other local audio manufacturers are setting up their own 'Oz Fi' organisation, to try and promote awareness of and pride in Australian-made audio products.

Jim Rowe

What's New In

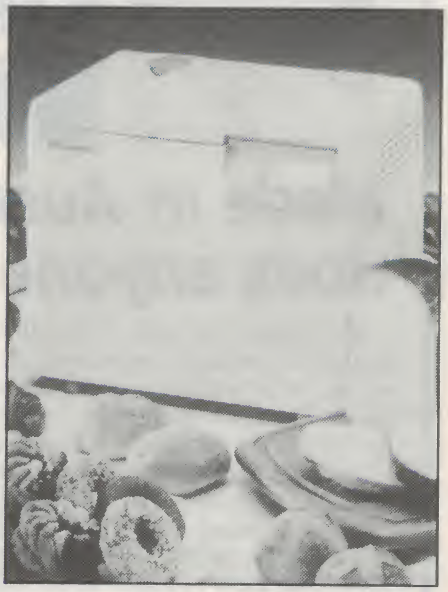
Entertainment Electronics

Panasonic releases first bread maker in Australia

Panasonic has released its ST-BT2P home Bread Bakery, the first of these appliances to be released in Australia. Measuring a compact 325×350×240mm and weighing 7.7kg, the unit performs all of the functions required to produce a small loaf of bread.

All the user does is place the ingredients in the appliance and press a button. The microprocessor-based unit then mixes, kneads, proves and finally bakes the loaf. The process takes around 4 hours, but operation is fully automatic and the unit also provides a timer function so that the sequence can begin at any convenient time – mid afternoon, while you are at work, or in the wee hours if you like fresh bread for breakfast. This is possible because the yeast is placed in a separate compartment from the other ingredients, and is only added during the mixing sequence.

Proven dough may be removed from the appliance before baking, if desired, to produce croissants and other fancy items.



According to Panasonic, home bread makers have already made a big impact on the Japanese and US markets, with over 1 million units sold in Japan during the first 11 months.

Recommended retail price for the SD-BT2P is $599, and there are apparently plans for marketing of bread mix packs to support the product.

Lightweight VHS-C camcorder from Sharp

Sharp's new VL-C73XA video camcorder is very compact and light, with a mass of just 1.2kg. The new model also boasts an 8X power zoom (claimed to be the greatest zoom range available in Australia on a domestic style camcorder), with macro function for super close-ups. The zoom speed is also variable, determined by the amount of finger pressure exerted on the zoom control.

To enable blur-free filming of sports events or any other fast moving action, Sharp has used an electronic high speed shutter (1/1000sec). This allows successful recording even from a moving car. When playing back the recording through a 3 or 4 head VCR, the still frame and slow motion images are very clear and free from noise bars.

A background music connection allows mixing of sound from a cassette player with the camcorder's microphone signal, while recording.

In addition to innovative features, Sharp has made simple operation a pri-

National becomes Panasonic, previews S-VHS in Australia

National Panasonic (Australia), local subsidiary of giant Japan-based electronics multinational Matsushita Electric, has decided to drop its use of the well-known 'National' brand name for consumer products, and replace it with the name 'Panasonic' as used in most other countries and in Australia for office and industrial products. This was announced by Matsushita president Mr Kiyoshi Seki, in Sydney recently for a national conference of NPA's retail dealers.

Mr Seki explained that a major benefit of the change for Australian consumers will be faster access to new products, and access to the full range of the company's products – including those from the UK, Europe and the USA.

The change has come in a significant year for both Matsushita and NPA. 1988 marks the 70th anniversary of Matsushita's founding in Japan, and the 10th anniversary of NPA being established in Australia.

At the conference, NPA also gave the first demonstrations of Super VHS in Australia. The demonstrations featured a Panasonic DSi S-VHS VCR, together with a matching 29" monitor fitted with S-VHS input facilities. Both units were NTSC format, as PAL models are not expected until later in the year.

The results were very impressive indeed, and certainly demonstrated the significant improvement in picture resolution, signal to noise ratio and stability provided by the S-VHS system.

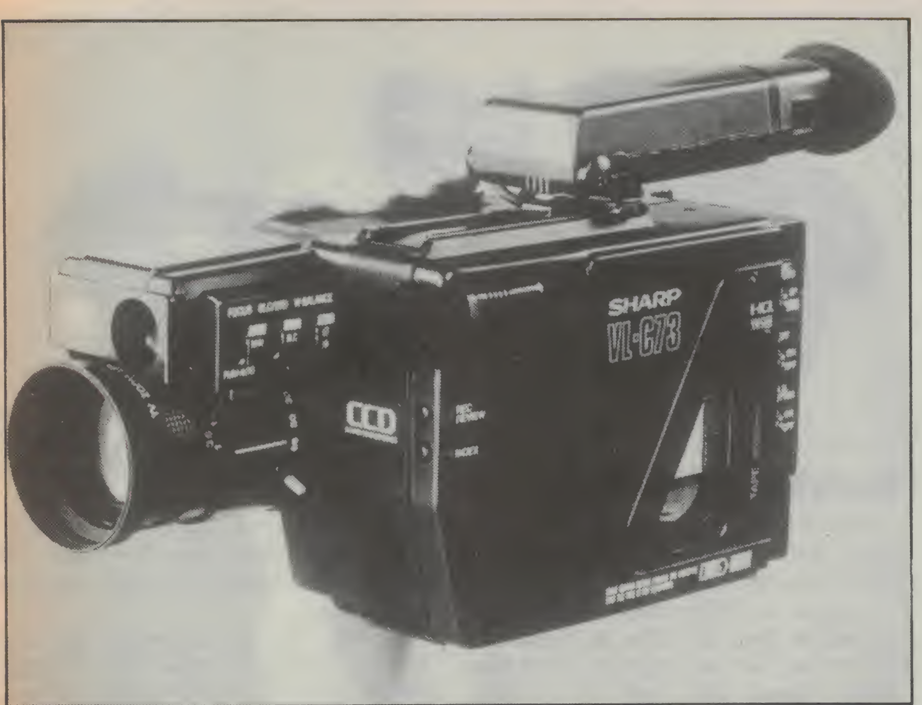
S-VHS machines will record and play standard VHS cassettes in addition to the new enhanced format, but S-VHS recordings cannot be played on a standard VHS machine.

New disco cartridges from Shure

Shure DC Series professional phonograph cartridges have been specifically designed for disco, nightclub and live DJ applications.

The models DC40, DC50 and DC60 cartridges are a new generation manufactured by Shure Bros of America, who have previously produced the world famous V15 Series and the professional SC35C phonograph cartridges. The new DC Series has been designed to offer disc jockeys both the 'punchy' sound reproduction they require plus the stamina to withstand the severity of repeated backcuing, all at an affordable price.

Three key design elements are claimed to contribute to the outstanding ruggedness of the DC series. A special cue guard design stabilises the stylus shank and prevents the shank from bending backwards or snapping off when backcuing. For reliability a high stiffness stylus shank has been em-



ority on the VL-C73XA, with easily located rear controls and automatic settings for focus, white balance, iris and auto standby.

Significantly increased picture quality (320,000 pixels) and ability to record in light levels as low as 10 lux are just two of the advantages resulting from Sharp's new higher density CCD image sensors.

Other features include an automatic date/clock function which can be superimposed on recordings for easy reference, a record review function to check the last few seconds of each scene, and an index search system to make it easy to locate a specific recording from among several.

The VL-C73XA comes complete in its own protective case with all accessories, including one hour battery, cassette adaptor, power adaptor, and leads to enable the connection of the VL-C73XA direct to a TV receiver. It has a recommended retail price of $3299.

ployed, while lateral stylus movement is limited by a wraparound stylus grip. This device prevents accidental damage to the stylus if the tone arm is dropped on, or slid across a record.

Brightly coloured stylus grips which glow under blacklight (DC40 glow red; DC50 glow blue; DC60 glow green) in a cut away design make the stylus completely visible. A bright orange dot on the top of the stylus tip itself makes for even greater visibility and ease in cuing up a record at night or when available light is limited.

For additional value and convenience Shure has 'value packed' each DC series cartridge with two additional replacement stylii in addition to the stylus mounted on the cartridge. Replacement stylii are packaged four to a box.

The Shure DC Series offers users a choice of tracking forces, stylus geometries, and mounting styles. The DC50 and DC60 both track in a range from 1 to 1.5 grams and have elliptical stylus tips; the DC50 is a P-mount, and the DC60 is a 1/2' mount. The CD40 tracks from 2.5 to 3.5 grams, has a spherical stylus tip and is a 1/2' mount.

Further information contact Audio Engineers Pty Ltd, 342 Kent Street, Sydney 2000 or phone (02) 29 6731.

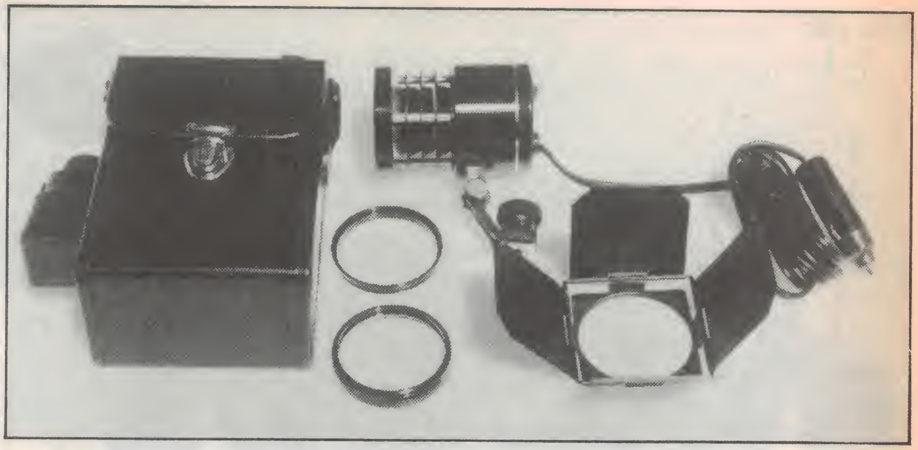
Copycode dropped

The US recording industry has abandoned plans to use the CBS-developed Copycode system to prevent home taping of recordings by means of DAT and other recorders. This follows testing of the system by the US National Bureau of Standards.

Carefully conducted NBS tests showed that listeners repeatedly identified the presence of the supposed 'inaudible' notch in Copycode recordings, proving that it does degrade sound quality.

The NBS also found that the copy protection it gave was highly dubious. It could easily be defeated using simple circuitry, while it gave unreliable protection even when no conscious effort was made to defeat it.

After the report was released, the Recording Industry Association of America (RIAA) admitted that 'the stark terms of the NBS report mean that Copycode is no longer politically viable'.



Portable video light

Newest product to expand the Arista audio and video accessory range is the AYL12 Arkon Video Light.

Compact and lightweight, it fits onto a standard flash light shoe or tripod and can be used in any situation (even outdoors) where extra light is required. Usage is approximately one hour between battery charges, which take about 12-15 hours.

The AYL-12 video light is supplied complete with a portable 12 volt, 6.5 amp-hour rechargeable battery pack, allowing freedom from restraining power points and power cords. Lamp power is a 100 watt quartz halogen globe with a 40° angle of coverage. Total weight of the unit is a mere 230 grams, which should not upset the camera balance.

Through the use of cooling fins, the AYL-12 remains cooler for extended periods of time. The mounting allows a full 90° tilt as well as swivel capability. Accessories include a charging power pack, shoulder strap, battery carrying case, barn doors and a heat resistant protective lens.

Further information is available from Arista retailers, or Arista Electronics, 57 Vore Street, Silverwater 2141 or phone (02) 648 3488.

New VHS recorder from JVC

JVC has released the HR-D210EA, which they see as one of the best value VHS machines on the market.

'The HR-D210EA is a quality machine that offers features which cannot be matched at the price. I believe people now are looking for reliable products rather than buying because of price – and who better to look for a video recorder than from the inventors of the VHS system – JVC' says Bill Dougall, General Manager for Hagemeyer (Australasia), distributors of JVC Consumer Products in Australia.

The HR-D210EA offers features including:

- The JVC-developed VHS Index Search System, which allows the recorder to search and automatically re-start playback at the beginning of the recording.
- On-Screen Pause Display – allowing a white bar to be displayed on screen when recording is taking place.
- Next Function Memory – by pressing a control button immediately after pressing rewind or fast forward, the VCR will enter the selected mode after it has reached the beginning (or end) of the tape.

Other features of JVC's HR-D210EA include 14-day 4 event timer; remote control operation; automatic functions (playback, power on, power off, eject, rewind, backspace, editing and pause release); shuttle search with locking function; noiseless still frame playback; instant timer recording; and electronic tracking controls with auto reset.

Recommended retail price of the HR-D210EA is $799.

Video equipment review:

Sony's new AU200, V50E camcorders

Among the new Video-8 camera/recorders just released by Sony are the limited edition "Bicentenary" economy model CCD-AU200, and the CCD-V50E model featuring a digital image memory and superimpose feature. Here's a first-hand report on both of these new models.

Above: The CCD-V50E, which features digital image memory, superimpose and time/date stamping.

A couple of years ago, in a previous existence, I took one of Sony's first Video 8 camcorders with me on a trip to Taiwan. Apart from the business of having to leave what seemed like an enormous deposit with the Taipei customs, to ensure that I took it back out of the country again when I left, it worked out really well.

It was really compact and light, much smaller than previous portable video gear I'd used. As a result, I was able to take it with me on both factory tours and the odd sightseeing trip, to capture events and impressions for the folks back home.

I confess that I started out a little skeptical, knowing that everything was being recorded on that tiny 8mm-wide tape – and that I was going to Taiwan during the summer, when it would be pretty humid. But the camcorder didn't skip a beat during the whole trip. It worked like a dream.

About the only minor trouble I had was using it in the car on one occasion, to capture a passing scene at short notice. I wondered why the focus was terrible, and then discovered that the autofocus sensor was being fooled by the car window glass! My fault for being lazy, of course.

But the thing that really impressed me was when I reached home, and viewed the material I'd recorded. Apart from the fairly so-so camerawork in places, the overall quality was excellent: sharp, steady pictures, with low noise and surprisingly good white balance even in quite poor lighting conditions. The sound was better than I expected, too.

Even dubbing it onto 1/2" tape (VHS actually – sorry, Sony!) still produced a result that compared very favourably indeed with pre-recorded tapes.

The CCD-AU200, Sony's limited edition 'Bicentennial' model, which offers all of the basic facilities - for an excellent price.

A close-up of the V50E camera control panel, showing the date and time stamping buttons.

I couldn't help but be impressed, and I guess the results were sufficient to convince me that Video 8 had a definite future.

Of course all this is by way of introduction, because Sony has released a number of new Video 8 camcorder models since the one I took to Taiwan. And a few weeks ago the company released yet a new clutch of models, including the two discussed here. Needless to say I was very interested in trying them out, to see what progress has been made.

The CCD-AU200

Simplest of the new models is the new CCD-AU200, which Sony calls its special 'Bicentenary gift' to the Australian people. At the time of writing this model has a special green-and-gold label and a price tag of $1988, to tie it in with the nation's celebrations.

Basically the AU200 appears to be a special 'economy' model, designed to attract support for the Video 8 format at the low end of the camcorder market. And I suspect it's likely to do that quite effectively.

For a start, it's very compact. I thought that the first model was compact enough, but this one is significantly smaller. It measures only 237 x 130 x 155mm overall (L x W x H), including the viewfinder, and weighs in at only 1.4kg – not counting the battery pack and tape cassette.

The balance and shape seem a lot better, too. The earlier machine wasn't bad, but the AU200 is particularly well balanced, and provided with a new adjustable handgrip/battery holder (also used in the other new models). You hold it in your right hand, with a Velcro-adjusted strap around the back of your hand, and your thumb directly over a standby slider/record button combination.

With the early model, all of the controls for the recorder section were at the rear – not entirely convenient, I found. However in the AU200 they're all up the front with the camera controls, with the exception of the SP/LP recording speed switch (which you don't need to adjust very often). This makes the unit rather easier to use, and certainly simpler in appearance.

Well then, what do you get for your money – or more importantly, what *don't* you get, that you would get if you were paying more money?

Quite a bit, or not much, as the case may be! As far as I can see the AU200 gives you almost all of the features of its more expensive brothers, at least as far as basic camcorder functions are concerned. About the only obvious 'economy feature' is a manual zoom lens, with a fairly modest zooming ratio of only 2.5:1 (from 12 to 30mm). But this still provides an aperture of f/1.6, and macro focussing down to about 90mm from the front of the lens.

On the positive side, the camera section features automatic focussing using infra-red sensing; automatic exposure; automatic linear white balancing; and high sensitivity. The minimum illumination level is quoted as 12 lux (1.1 foot-candles), although the recommended minimum illumination level for best results is 300 lux. Maximum illumination level is 100,000 lux, unless a neutral density filter is used (46mm thread). Needless to say the camera uses a modern CCD (charge-coupled device) image sensor, with consequent freedom from flare and comet tailing on bright spots.

In addition to auto white balance, the camera also provides fixed settings for daylight (5800K) and tungsten (3200K) lighting. It also provides a backlighting compensation button.

The camera's electronic viewfinder uses a 0.7" black and white tube and provides adjustable eyesight correction. The viewfinder tilts through 90° for convenience in shooting from various angles, and is also removeable to allow packing the camera away conveniently in a suitcase.

The recorder section provides both SP (standard play) and LP (long play) record/playback modes, giving up to 3 hours recording. It has all the usual facilities, including fast forward, rewind, playback and pause. There is also a *Recording review* button, to allow you to view the last few seconds of the previous 'take' in the viewfinder. The recorder then automatically goes into pause/standby mode, ready to shoot the next scene.

The viewfinder can also be used as a built-in monitor to look at your recording at length, in replay mode – handy when you're away on a trip.

Despite the AU200's modest pretensions, the tape scanning drum features a *flying erase head*, for noise-free transitions between takes. It also provides both external indication and viewfinder signalling for a variety of modes and

New Sony camcorders

problem conditions, including *Battery Low* and *Dew* (excessive moisture condensation). The wonders of modern microprocessor control!

Like all of the Video 8 camcorders announced to date, it uses the AFM sound recording system. There is a built-in electret microphone, also a pair of jacks and a standard accessory shoe for the addition of an optional external mike.

At the rear of the AU200 are the normal video and audio outputs, for replaying your recordings via a normal monitor or TV receiver. These are via standard RCA-type 'phono' connectors, and provide 1V p-p at 75 ohms and -10dB at 2.2k respectively.

For replay via a standard PAL colour TV set, a small RF modulator unit (RFU-88E/ASD) attaches to the output sockets. This is powered via a miniature jack and socket, between the two signal connectors. It provides RF selectable on either of VHF channels 0 or 1.

Power for the AU200 comes from a 6V rechargeable battery pack, which slides inside the camcorder's handgrip. A fully charged battery pack provides about 1 hour's operation.

For playback or recording in your home/office, there's an alternative mains pack which slides into the grip instead. The same mains pack is also used to recharge the battery pack (out of the camera), using a small 'charging adapter' unit into which both are plugged.

Rear view of the V50E camcorder, showing the video and audio outputs at lower left and the main control button at upper right.

Charging takes about 1.5 hours for a completely exhausted battery, and is automatically terminated when the battery is fully charged.

By the way, the AU200 comes complete with battery pack, mains pack, charging adaptor and all cables. Sony hasn't reduced the price artificially, by turning some of the essentials into 'options'!

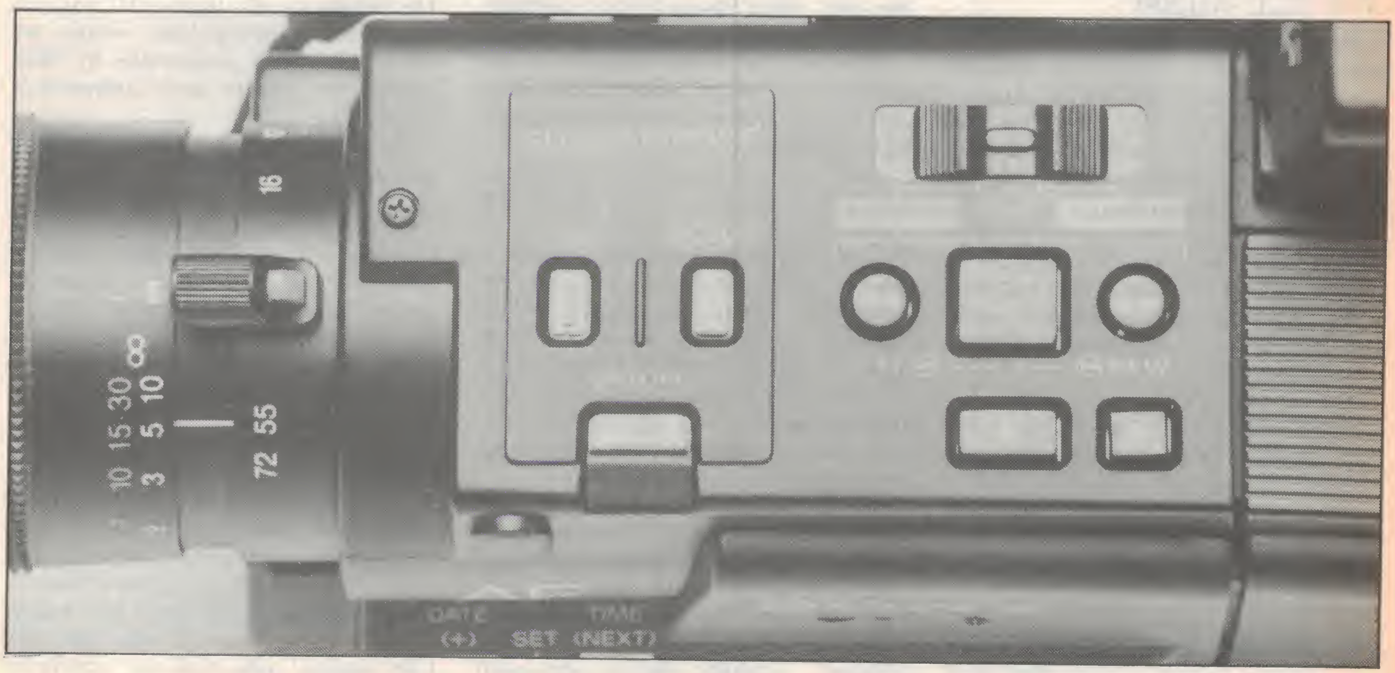
The CCD-V50E

So much for the economy model, which has goodies enough. What more do you get with its big brother, the V50E?

Well, for a start, you get a *power* zoom lens, with a somewhat wider 6:1 zooming ratio (12 - 72mm). Apart from this the lens has the same basic aperture of f/1.6, and the same features as for the smaller unit – even in terms of minimum illumination level.

The other main 'extra' you get with the V50E is a *digital image memory* and superimpose facility. The idea of this is that you can store an image, typically a simple title, in the camera's memory chip, and then superimpose it on any desired scene later on, at the touch of a button. So you can superimpose the title over some live action, for example - or over a suitable background scene.

The V50E manual doesn't specify the



A top view of the V50E, showing the deck control buttons, superimpose controls and lens control rings.

pixel resolution of the digital image memory, but it seems to be what I can only describe as 'medium' resolution. It's OK for fairly big, bold title lettering, either printed or in script – although you can see some 'staircasing' on oblique lines and curves.

The memory only stores a high contrast two-tone image, too; there's no grey scale capability. But on the other hand, you aren't limited to just black on white: the camera can store the image in various synthetic colours instead. You have a choice of blue, green, cyan, red, violet, yellow or white (i.e., reversed). So it's quite flexible, in practice.

During recording, the title or other image in memory can be turned on or off at any desired time, simply by pressing the *Memory on/off* button. A big advantage of this system over a fixed character-generator titling system is that it will cater for titles in languages other than those using the Roman alphabet - like Arabic, Chinese, Japanese, Russian or Greek. And also for simple graphics, of course.

Incidentally the V50E comes complete with a small fold-up cardboard titling stand, which even includes a range of pre-printed title cards and images.

The third additional feature with the V50E is *time and date stamping*. The camera has a built-in digital clock and calendar, which can be used to superimpose either the time or the date on the picture being recorded, down in the lower right-hand corner.

This feature would no doubt make the V50E particularly suitable for security and surveillance work, as well as being handy for recording ID information on normal recordings.

Apart from these additional features, the V50E is essentially much the same as its little brother. The picture resolution of the V50E is quoted at 291,000 pixels. Although no comparable figure seems to be given for the AU200, a few quick tests suggest that it is the same. I suspect that the basic camera and recorder used in both models is identical.

Recommended retail price for the V50E is $3125 – rather more than the AU200, to be sure, but you do get those extra features. By the way the V50E measures 306 x 130 x 157mm (L x W x H), and still weighs in at a modest 1.5kg. So the bigger zoom lens and the other goodies only contribute another 100 grams.

How they perform

We tried out both cameras with a variety of different kinds of subject, and

A look inside the cassette compartment of the AU200, with the head drum at lower centre. The V50E is almost identical.

in various lighting conditions. They were both very easy to manipulate, thanks to their light weight and nice balancing. They are both also quite easy to 'drive', with the controls quite logical and conveniently positioned.

The AU200 is particularly easy to use, partly because it does have a few less buttons and frills. Yet in our tests it produced excellent results – in terms of basic video and audio recording, quite the equal of its more expensive brother.

Sure, it has a more modest zoom lens, so you can't capture distant events as conveniently. But you must accept *some* limitation, being in mind that you're saving around $1100.

As it happens, I suspect that for many people, this limitation isn't likely to be much of a problem. The AU200 really has all of the facilities needed to make excellent video 'home movies', and at the price it's surely excellent value for money.

Certainly the V50E does have greater flexibility, with its 6:1 power zoom lens and the image store/superimpose feature. The latter seems to work well, although as mentioned earlier the digital storage chip seems to have only medium resolution. There's a little fine 'staircasing' visible on oblique strokes and curves, but not enough to be a problem. As a simple approach to providing superimposed titles, it's fine. About the only thing you have to watch is to not jar the camera when you press the memory on/off button, when you want to have the title appear in the picture mid-take.

We also liked the convenient location of the rocker switch for the power zoom, just where your fore and index fingers tend to rest around the grip. So once you train your hand, all of the main controls are right at your fingertips.

The date/time stamping feature is also easy to use, and will no doubt increase the V50E's appeal for more specialised applications. I imagine it might become standard equipment for self-respecting private inquiry agents!

Seriously, though, the V50E is likely to have enhanced appeal for the more serious camcorder user, who can make use of its extra features.

Both the AU200 and V50E units seemed to give an overall resolution of between 200 and 250 lines, when played back through a typical TV receiver via the RF adapter. I suspect you could get a little better than this with direct video connection, but we didn't have one available to try.

In any case this result compares very favourably with pre-recorded tape material on the domestic 1/2" formats - either Beta or VHS.

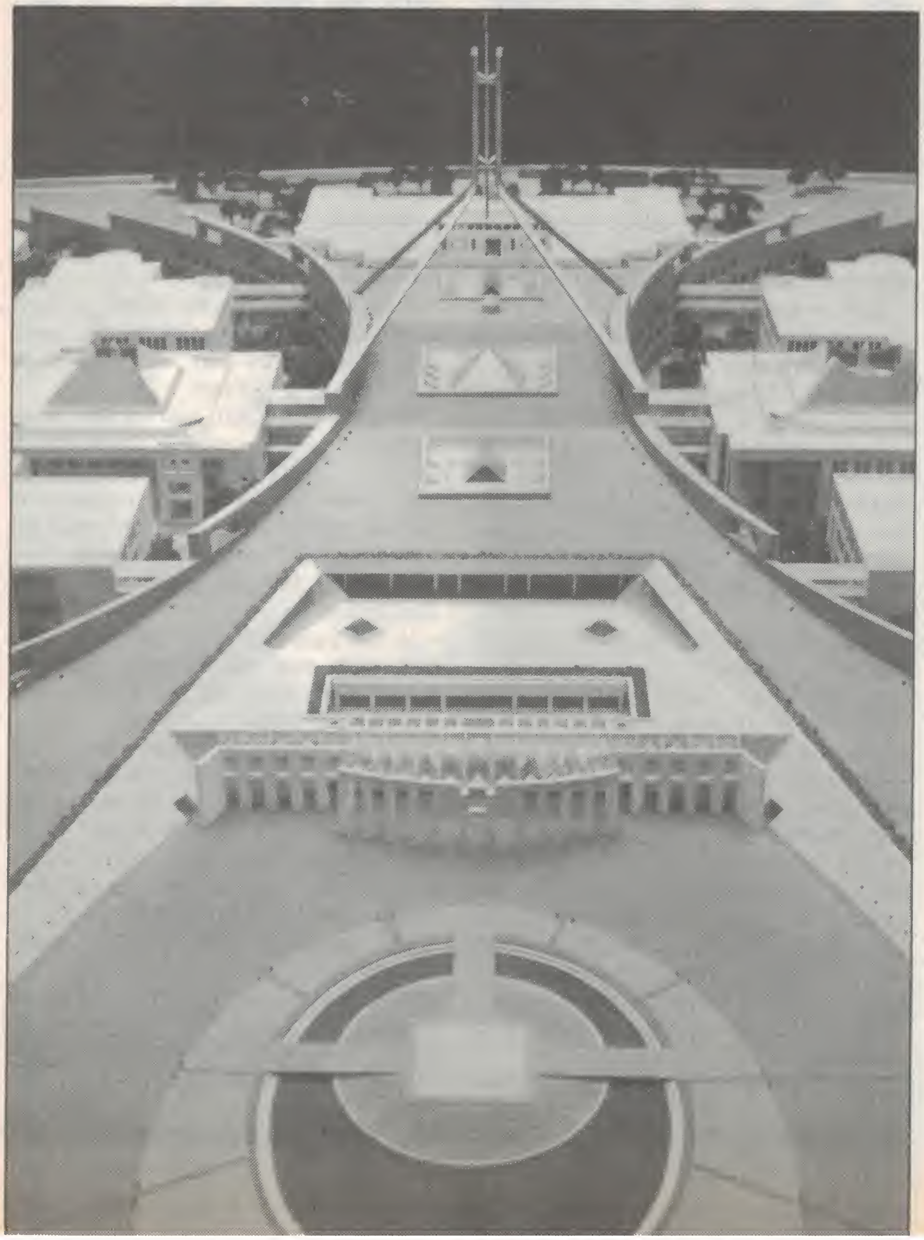
All this from such compact little machines. I remember when home movie enthusiasts used to laugh at people lugging around those first 'portable' video combinations, and joke that they'd never really compete with film cameras. I don't hear much laughter nowadays...

The sample AU200 and V50E camcorders discussed in this review were kindly loaned to us by Sony (Australia) Pty Ltd, of 33-39 Talavera Road, North Ryde. You should be able to see them at your nearest video dealer. (J.R.)

Our new Parliament House is

Wired for sound, TV and data comms

Australia's new Parliament House in Canberra is remarkable not just because of its impressive architecture and massive cost, but also for its innovative and comprehensive sound, vision and data communications network – the result of a co-ordinated design and manufacturing effort by Australian firms and organisations.



According to the designers, the sound and vision systems in Australia's new Federal Parliament House incorporate the very latest technology, and are capable of meeting virtually all current and anticipated requirements for broadcasting.

There are actually a number of overlapping systems, all of which are effectively integrated into a single vision, sound and data communications network. The individual systems are to provide the following functions:

Sound Broadcasting A network of microphones deployed throughout the two chambers will allow sound broadcasting of proceedings, with full provision for stereo. An announcer's booth allows for the traditional identification of senators and members when speaking. Also provided as part of this system are speech reinforcement within the chambers, attendant call facilities, language translation, assistance for the hearing impaired and headphones for the press gallery.

Television Broadcasting A broadcast-quality television system is provided, covering not only the Senate and House of Representatives, but most committee rooms as well. The design provides for ultimate installation of sufficient cameras to cover adequately all senators and members, in both chambers and committee rooms, all remotely controlled. A novel system of remote camera and equipment assignment allows very flexible access from different control rooms. This provides for various types of coverage, from simple one-operator control for basic closed-circuit operation to complex production control for broadcasting of special events.

The television system will mostly be used for closed-circuit vision distribution via the house monitoring system. All cameras are mounted within wall structures, at an appropriate height for optimum coverage.

Checking out the video recording machines and their controllers.

Video Hansard An automated broadcast quality audio/video recording facility allows simultaneous recording of proceedings in both chambers and 19 committee rooms, via a highly sophisticated master control room and editing suite. It is planned that this system will ultimately form the basis for future introduction of Hansard recording in audio-visual form.

House Monitoring The house monitoring system is basically a multi-channel radio and television cable system, which provides information on proceedings and activities within all major areas of the building - as well as access to all television and radio broadcasting network signals. Outlets of the house monitoring system are provided throughout the building in Ministers' suites, senators' and members' rooms and support facilities, in a similar way to telephones. The house monitoring system will therefore keep all occupants of the building in constant touch with all proceedings.

Public Address Public address and emergency warning systems are integrated to provide the necessary distribution of voice and other aural signals (including the chamber division bells) without which a Parliament could not function properly.

The massive size of the building and the need to be able to access every room, no matter how small, has dictated a very special PA system. It includes some 12,000 ceiling mounted loudspeakers, and 58 different input facilities to allow access to specific areas.

Clocks and Division Lights The clock and division light system is technically tied to the television system, and indirectly to the PA system. Each of the building's 2500 clocks is slaved to a master precision clock, and each clock face is fitted with small red and green lights to indicate in the traditional manner which House is being called. There are a further 500 sets of division lights, in addition to those fitted to the clocks. When a division is called in either House, an appropriate bell sound is broadcast through the building via the PA system, in addition to the flashing lights.

Media Offices Within the new Parliament House are provided facilities for accommodation of the various media groups, and appropriate to their requirements. These range from small audio booths to small sound and vision studios.

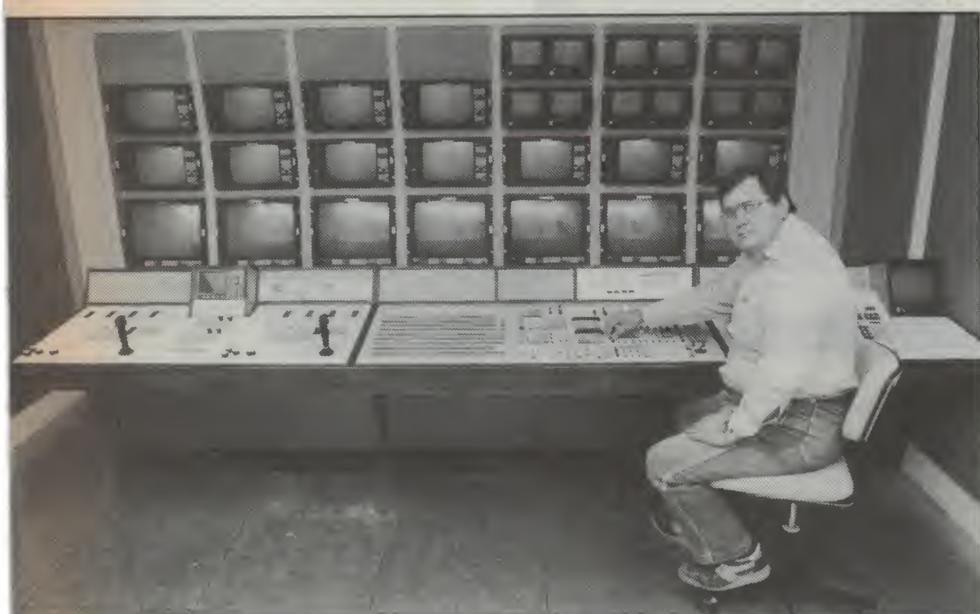
Data Communications A comprehensive system of six Ethernet local area networks provides for data interchange within and between local networks, and access to a large central database. Terminals for accessing the networks can be provided in all relevant suites, offices, chambers and committee rooms.

All of the equipment for these systems that is visible in the Parliamentary chambers and other public areas is integrated with the architecture of the building, so that – for example – while excellent facilities are provided for both television and radio broadcasting, there will be virtually no impact on either the function of Parliament, or the architectural ambience.

Overall responsibility for the design, construction and installation of these very comprehensive sound and vision facilities was given by the Parliament House Construction Authority (PHCA) to the Australian Broadcasting Corporation, because of its long involvement in the broadcasting of Federal Parliamentary proceedings. The ABC in turn engaged smaller Australian firms such as Andrew Sweeney Electronics and Murray Amplifiers, who undertook the detailed work.

Andrew Sweeney Electronics (ASE) assessed, pre-tested and installed all of the automated control room and audio/video equipment for the broadcast standard recording system, and also provided the special broadband cabling which provides the backbone for the House monitoring and data communications networks.

The audio operations console was designed and manufactured by ASE, in



A view of the main video operations console, taken during the commissioning. (Pictures courtesy Andrew Sweeney Electronics)

Wired for sound, TV and data comms

conjunction with the ABC. A simulated control room was set up at ASE's premises in Artarmon, Sydney and fully tested before being shipped to Canberra.

The speakers and amplifiers were designed and built by Murray Amplifiers, which is also based in Sydney.

The fully automated television camera and control room facilities use wall mounted Hitachi cameras with Fuji lenses. Current camera positioning is stored in computer memory, with manual over-ride if necessary. The automated pan and zoom facilities were developed in the UK by Vinten.

The original plan allowed for seven cameras in each chamber, and from two to five in each of the committee rooms depending on size – a total of 68 cameras. However due to budgetary cuts this was first reduced to 31 cameras, and then more recently to only four: two in each chamber. However provision has been made for 31 camera locations within the walls, and these holes will be enclosed until the remaining cameras can be installed.

The reduction in automated cameras means that for adequate coverage of the Queen's opening of the new building this month, many additional cameras and crews will be needed. These would not have been required with the system as originally planned.

The broadband network used for communications within the building consists of three cable systems, which are expected to provide for all likely requirements. Because the numerous communications channels are provided by frequency multiplexing rather than discrete wire conductors or cables, the changing needs of the building can be met without constant re-arrangement of physical cabling or modification of complex distribution frames.

Two of the broadband cable systems are used for the reticulation of audio and video signals as required for the House monitoring system. Each of these cable systems offers some 48 discrete channels of 7MHz bandwidth, compatible with PAL format television. All audio signals regardless of their source (live, recorded or off-air) are modulated or re-modulated to stereo FM.

The third broadband cable system is used for comprehensive data communications throughout the building. This system has been installed and commissioned by ASE subsidiary Broadband Network Communications, and provides six Ethernet local area subnetworks covering the House of Representatives, Senate, Electronic Hansard, Executive, Library and Joint Departments. Each of these networks can communicate within its own confines.

When a subnetwork communicates with another subnetwork or the master database, the signal travels via an Ethernet data bridge through a broadband "head end", located in the annex of the main computer room. This provides a network control facility. The overall data communications system is described as a high-split system, and allows bidirectional flow of equal amounts of data in accordance with IEEE.802.7.

All in all, the communications systems within our new Parliament House are most impressive, and thoroughly in keeping with the building's status as the most modern building of its type in the world. As such, they're surely a great credit to the ABC, Andrew Sweeney Electronics and the other Australian organisations responsible for their design and installation.

What's inside the latest Microwave Ovens

No longer in the 'luxury toy' category, microwave ovens are now firmly established as a key appliance in both domestic kitchens and restaurants. Here's a look at what the latest models can do, and how they do it.

by JIM ROWE

Ask most people to name the electronic gadgets that they use most in their daily lives, and they're likely to list their TV set, radio, hifi system, video recorder, CD player and perhaps a personal computer. The odds are they'll forget an electronic appliance that's now in the majority of kitchens, and used just as much as any of these: the ubiquitous microwave oven.

Microwave ovens are now so much a part of our daily lives, in developed countries like Australia, that we take them for granted. I guess that's because they're not used for fancy processing of information, but for the much more down to earth job of processing our food. A job that's just as important, of course, but perhaps not as spectacular.

But in reality, the humble microwave oven is just as important an application of electronics as any of the more high-profile appliances. It's also quite an interesting one, because it's an application of electronics to meet a very basic and long-standing need (heating food) - and in a particularly elegant, efficient and "user friendly" fashion.

Microwave ovens have come quite a long way since they were first introduced in the early 1960s. The latest models are fitted with a microprocessor controller, which in some cases gives them the ability to cook the food fully automatically, after you've told them the kind of food involved and the result you want. In short, they're a far cry from the crude units which first appeared on the market, with little more than a "go" button and a mechanical timer to adjust the cooking time on a "try it and see" basis.

The basic idea

Yet as the experts are quick to point out, today's microwave oven is still basically similar to those first crude models. They're both essentially a power supply and magnetron valve to turn electrical power from the mains into microwave radio energy, plus a metal enclosure into which the radio energy is beamed, to heat the food placed inside.

If you like, a radio transmitter with its output waves all directed inside a "tin", to heat up your cup of coffee or cook your chook, leg of lamb or whatever.

Why do they work at microwave frequencies? Basically because the higher the frequency of the radio waves, the faster the food heats up - and speed is an important feature, in the modern world.

Concentrated radio waves heat food because the strong alternating electromagnetic field distorts electrically charged food molecules first one way, and then in the reverse direction. This alternate tugging in opposite directions generates frictional heat, and the faster the field reversals take place, the more heat is generated.

The only qualification to this is that if the frequency is increased too far, the radio waves can't penetrate very far into the food, and heating tends to be concentrated in the outer layer.

In fact the optimum frequency turns out to be around 2450MHz (2.45GHz), in the microwave spectrum. This happens to be just the right frequency for optimum heating of the water molecule (H_2O) - and water is of course an important component of most food. So nowadays most microwave ovens operate at this frequency.

Note, by the way, that microwave energy causes heat to be generated inside the actual food itself. It's this that makes a microwave oven so efficient - it doesn't waste a lot of energy heating up the oven, dishes and whatever. The energy is essentially directed right into the food.

Modern microwave ovens still use a magnetron valve to generate the required amount of 2.45GHz radio energy, just like the first ovens produced around 1962. That's because a magnetron is still the simplest and most reliable way to generate the required 400 to 900 watts of continuous microwave energy.

Yes, that power level is equivalent to the output from quite a husky microwave transmitter or radar set. And magnetron valves were developed in the 1940s, specifically for this purpose.

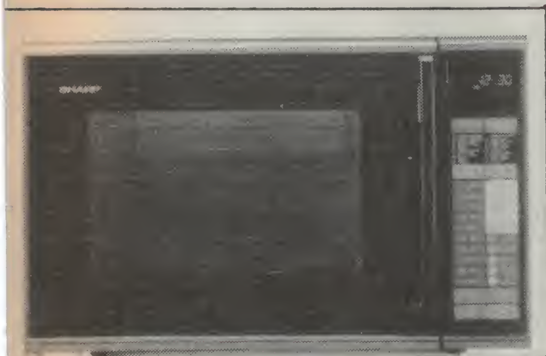
So in a sense, a modern microwave oven effectively combines a radar transmitter and a computer, both with the sole job of heating up your tucker!

Making the microwaves

But back to the magnetron. How does it work? Essentially it's a fancy kind of diode valve – simplest valve of all. Just a heated cathode, boiling off electrons in a vacuum, and with a cylindrical metal anode placed around it, with a positive voltage on it to attract the electrons...

Well, not quite. In a magnetron the anode is in the form of a cylinder with internal fins, as shown in Fig.1. And the fins are carefully arranged so that the little cavities between them are electrically *resonant*, at the magnetron's operating frequency - in this case, 2.45GHz. In other words, the inductance of the fins and the capacitance between the walls of the cavities can interact, just as in a normal tuned circuit, producing a natural tendency to oscillate at this frequency.

Right: The new Panasonic NN9807, which offers all of the features discussed in the text – including mixed microwave/convection cooking, and automatic cooking via a humidity sensor. (Courtesy Panasonic)



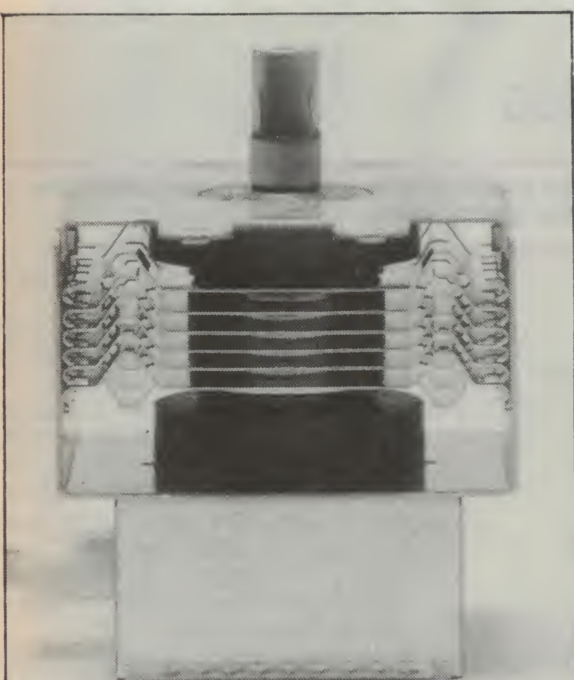
Left: The new Sharp R-8580, which also offers the same advanced features. (Courtesy Sharp)

As well as that, ring-shaped *permanent magnets* are placed at top and bottom of the magnetron, so that there's a strong magnetic field passing through the valve axially, in a direction parallel to the cathode. It's this magnetic field that gives the valve its name, of course.

Now the anode and its fins are typically about 4000V positive with respect to the cathode, so electrons leaving the cathode tend to be accelerated towards one of the fins by the strong electric field. However once they're moving, they become influenced by the axial magnetic field, which tends to deflect them around in a circular path.

The nett result of this interaction is that the electrons tend to be swung back towards the cathode. However in swinging around, their electrical charges distort the electric field in the gaps *between* the fins, and this tends to excite the fields inside the cavities - so they begin oscillating, at their resonant frequency. And in giving some of their energy to the electric field, to excite this oscillation, the electrons are slowed down. This reduces the influence on them of the magnetic field, so they tend to move outwards again towards the fins.

If the ratio of the two fields is carefully adjusted, what happens is that the electrons do gradually move outwards and eventually reach one of the fins, but they do so in *cycloidal* paths, in the process donating most of their energy to the oscillations in the cavities. As a result, the inner ends of the fins tend to develop a strong AC voltage at 2.45GHz, superimposed on the DC voltage. When one fin is more positive,



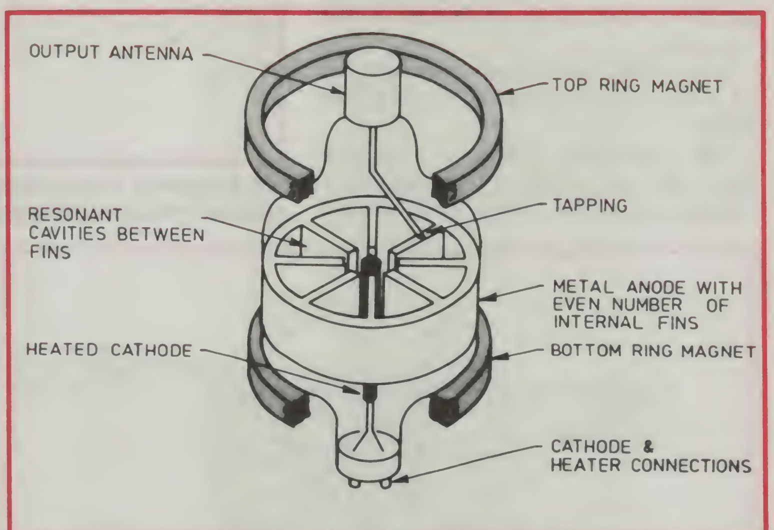


Fig.1 (above): The basic construction of a magnetron, which forms the heart of all current microwave ovens.

Left: A complete magnetron assembly, without output antenna at top, the valve itself centre with ring magnets and cooling fins, and its cathode filter components in the shield box below.

Microwave ovens

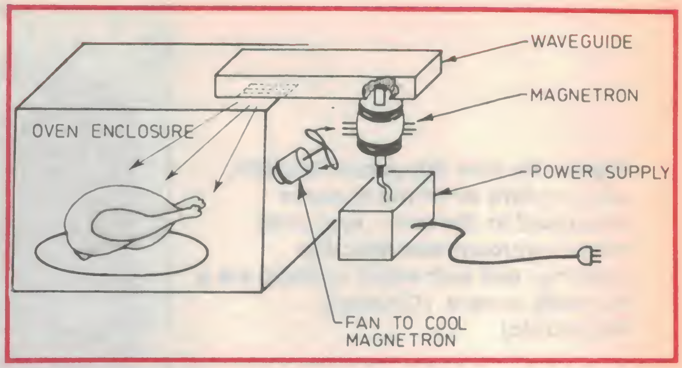


Fig.3: A basic microwave oven. A magnetron produces RF energy at 2.45GHz, which flows via a waveguide into the oven enclosure.

the next fin is more negative and so on.

This in turn causes the electrons to "bunch together", in a relatively small number of radial streams or "curtains" of *space charge*, which rotate around inside the valve - rather like the poles of a rotary switch, or commutator. And the curtains rotate at a speed synchronised with the oscillations of the cavities, so that they move from one fin to the next in one half of a cycle at the magnetron's resonant frequency.

If the magnetron has say eight fins (and therefore eight cavities), there will be four of these space charge curtains rotating around inside, moving between one fin and the next in about 0.2 nanoseconds (the time for one half-cycle at 2.45GHz). This is shown in Fig.2. Each curtain will make a full revolution every 1.63ns.

So the magnetron effectively works like a very rapidly rotating multi-pole switch, switching DC electrical power into the oscillating cavities - and potentially generating large amounts of microwave power in the process. It's a very compact and relatively efficient power converter.

Actually to ensure that everything happens as just described, there's one little detail inside the magnetron that I haven't mentioned yet. This is that there are circular *straps* used at each end of the magnetron's fins, to connect every alternate fin together (Fig.2). The straps make sure that the oscillations of the various cavities are all synchronised together, and change polarities at the same time.

Incidentally the actual operating life of a magnetron is typically around 2000 hours.

The microwave power is extracted from the magnetron by connecting a tapping near the outer end of one anode fin. Generally the tapping lead comes out of the magnetron at the opposite end to the cathode heater leads. Its end forms a very short microwave transmitting antenna, used to couple the microwave energy into a *waveguide*. This is the microwave equivalent of a transmission line cable - at these frequencies, it becomes purely a rectangular metal pipe leading the microwaves to their destination.

The basic oven

In the case of a microwave oven, of course, the destination is the metal oven cavity itself, containing the food to be heated. Needless to say the oven cavity itself is also carefully designed to be resonant at 2.45GHz.

The basic physical arrangement of a microwave oven is therefore as shown in Fig.3. A power supply provides energy to the magnetron, which converts it into microwave energy. This is then led by the waveguide along and into the oven cavity, to heat the food.

Although the magnetron is relatively efficient in converting the input DC power into microwave energy, it is not perfect. The remaining power is dissipated as heat, in the magnetron itself. As a result the magnetron is usually mounted in a finned heatsink enclosure (see picture), with a small fan used to blow cooling air through the fins. It's this fan that generates most of the "rushing air" noise evident when most microwave ovens are operating.

The basic circuit of a microwave oven is shown in Fig.4. As you can see, it's pretty straightforward.

The magnetron itself is connected with its metal anode earthed. Its cathode and heater must therefore be connected to a supply of -4000V, with respect to earth. The actual heater leads are brought out of the magnetron enclosure via RF chokes and feedthrough capacitors, as shown, to prevent leakage of the microwave energy.

The heater itself typically operates from about 3.3V AC, supplied directly

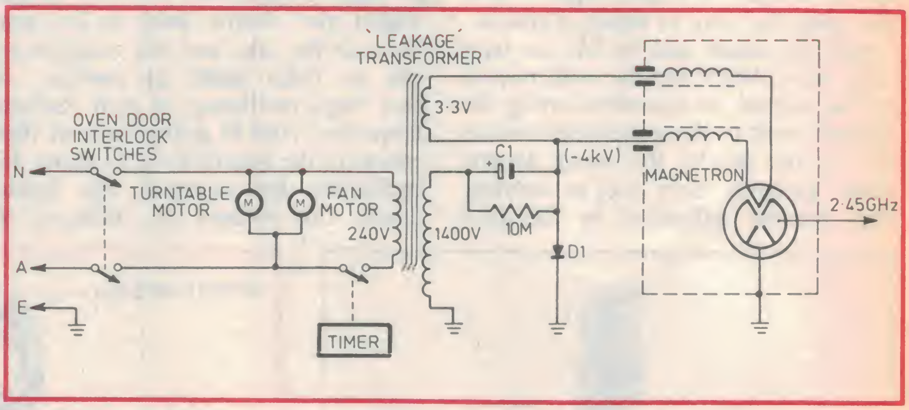


Fig.4 (above): The basic circuit used in most modern microwave ovens. The main differences arise with the 'timer' section.

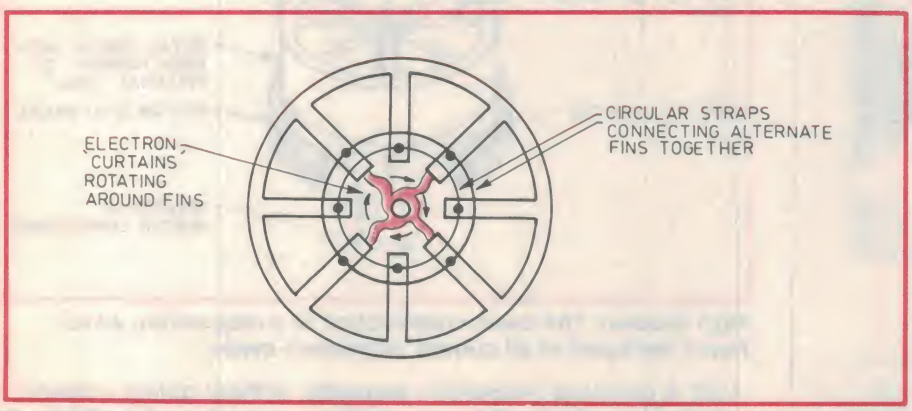
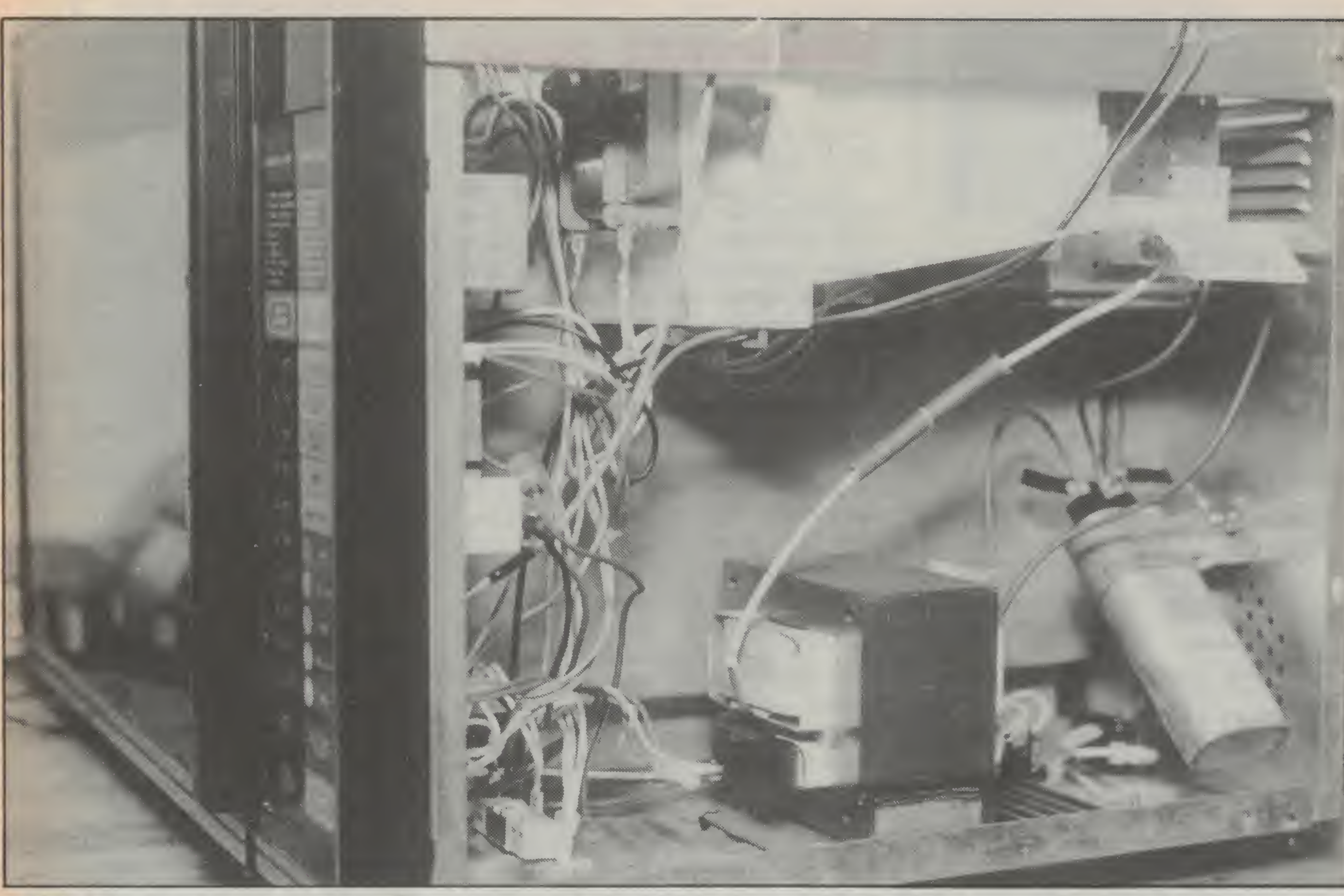


Fig.2: Inside the magnetron, electron 'curtains' rotate around the anode fins at very high speed, like a commutator switch.



Inside a modern microwave oven. The magnetron assembly is at upper right, with its transformer and doubler capacitor below and cooling fan at top centre. (Courtesy Sharp Corp. Australia)

from a winding on the power transformer. The negative DC cathode voltage is derived from a high voltage secondary, via a simple "half-cycle doubler" rectifier circuit. This consists essentially of capacitor C1 and diode D1.

It works as follows. When the top end of the transformer winding is positive, diode D1 conducts and capacitor C1 charges up with the polarity shown, to the peak value of the winding voltage. Then when the top of the winding swings negative, its voltage adds to that across the capacitor, boosting the voltage across D1 (and the magnetron) to a level equal to the full peak-to-peak voltage of the transformer winding.

As the transformer winding produces around 1400V RMS, the voltage applied to the magnetron is therefore approximately 4000V. Note, however, that this is not steady DC; it is essentially a 4000V peak-to-peak AC sinewave, superimposed on a 2000V DC level (Fig.5). So the magnetron actually only operates in short bursts, on alternate half-cycles of the 50Hz mains input.

The 10M resistor is a "bleeder", to discharge capacitor C1 when the power is turned off.

This is very important from the point of safety, for servicing personnel. The capacitor concerned typically has a value of 0.9uF, and carries a charge of 2000V DC. That means it stores just on 2 *joules* of energy - more than enough to kill someone, in the wrong circumstances.

In fact although the power supply inside a microwave oven is essentially quite a simple affair, don't forget that it's designed to deliver upwards of a KILOWATT of power at 4000 volts.

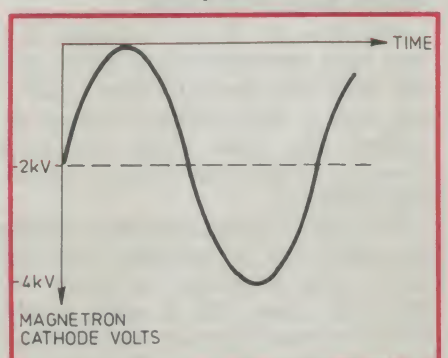


Fig.5: The simple 'half-cycle doubler' power supply used in a microwave oven delivers 4kV negative pulses to the magnetron cathode, every 20 milliseconds.

This makes it far and away the most dangerous power supply in any item of domestic equipment - bar none.

So never underestimate the danger lurking inside a microwave oven's power supply. It won't just give you a nasty shock and throw you across the room, like a TV set's EHT supply. It's highly lethal, make no mistake!

This in itself is a good reason to leave the repairing of your microwave oven to the manufacturer's service department, by the way. They also have the specialised test gear to ensure that the oven isn't leaking microwave energy - another potential danger.

Turning back to Fig.4 for a moment, you've probably noticed that the transformer is described as a "leakage" transformer. This is because the current drawn by a magnetron tends to vary widely, for a small change in its applied voltage. In a microwave oven its current also tends to vary a lot due to changes in the loading on its microwave output, with different kinds of food in the oven. To protect the magnetron from damage it is therefore desirable to provide the power supply with a measure of automatic current regulation. An elegant way of doing this is to give the trans-

former a high leakage inductance, usually by means of an air gap in the core.

As you can see, apart from the magnetron and its power supply, there isn't much more to a *basic* microwave oven. Apart from small motors to drive the cooling fan and the food turntable, there's mainly a timer switch to apply power to the magnetron for the desired period of time.

Of course there's also the interlock switches operated by the oven door latches, to make sure that power cannot be applied to the magnetron unless the door is shut. This is again a very important safety point. The door of the oven is also very close fitting and carefully made, to ensure that when it is shut the intense microwave energy can't leak out. This involves special "quarter wave" trap slots inside the door, and ferrite-loaded sealing strips. There are very stringent safety specs which these appliances must meet before they can be sold.

Before leaving the basic microwave oven, we should perhaps note that both these and more elaborate ovens are made in about three main sizes. These have cooking enclosures of approximately 16, 27 and 42 litres in volume, with rated maximum microwave power levels of around 500W, 650W and 700W respectively.

It's also worth noting that the rated power level of a microwave oven is worked out from the temperature rise in a 2000mL water load when it is heated for 168 seconds. The rated power level (in watts) is then found by multiplying the temperature rise (in degrees C) by 50.

Bells and whistles

OK then, so far we've looked at a very basic microwave oven, of the type that first went on the market - and is still sold at the economy end of the market. But what about the more advanced models, with those fancy bells and whistles?

Well, the first improvement is actually the addition of a turntable inside the actual oven enclosure, to rotate the food and ensure that it cooks evenly. This is necessary because the microwave energy tends to form *standing waves* inside the enclosure, with some areas having stronger field intensity than others.

Before turntables were fitted, it was often necessary to stop the oven and move the food around by hand, to ensure even cooking. The only other approach was to have a metal "stirrer" blade rotating inside the top of the oven, to direct the microwave energy in different directions and prevent the formation of standing wave.

Sharp Corporation first produced an oven with a "carousel" turntable, in 1966. Nowadays they're fitted to all but the very cheapest domestic models, and some specialised commercial ovens.

The next enhancement is adjustable cooking power - some kind of control to let you cook at high power, medium, low or whatever. Nowadays most models give you a range of say 5-6 cooking power levels, to allow greater control over cooking.

Interestingly enough, this adjustment of cooking power generally *doesn't* involve any kind of analog control over the microwave power delivered by the magnetron. Magnetrons aren't really capable of adjustable power output, they tend to either deliver full power or nothing. So power control is achieved in "digital" fashion, simply by varying the *proportion* of total cooking time that power is fed to the magnetron.

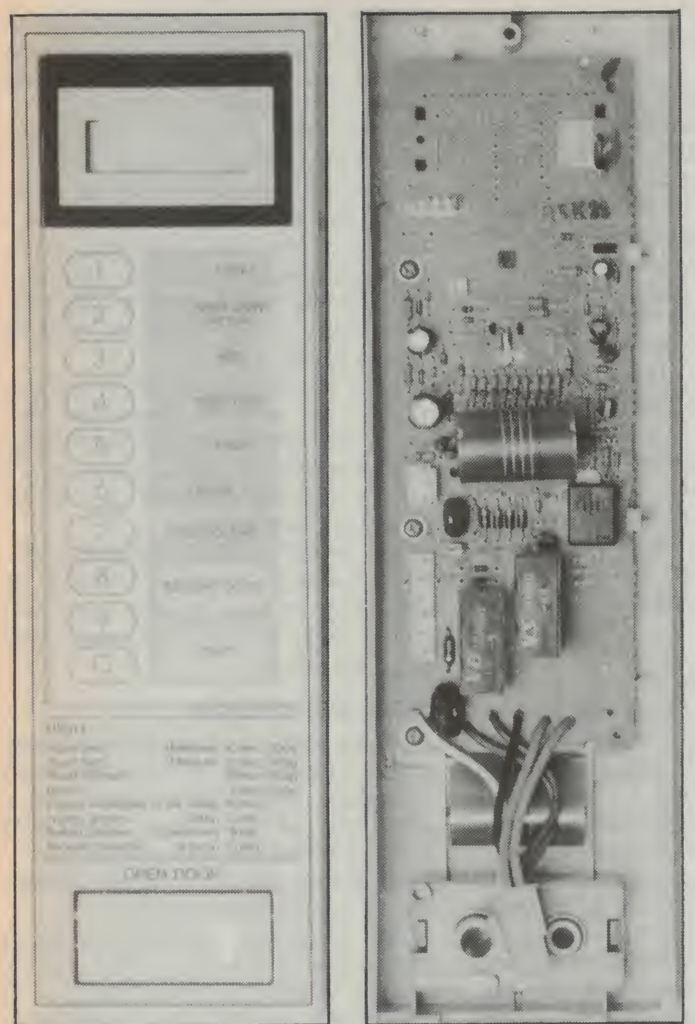
So on the "high" power setting, the magnetron is on for the total cooking time, but for say "medium high" it may be on for only 80% of the time. For "medium" it's likely to be on for about 60% of the time, for "medium low" about 30% and "low" about 15%.

This on-off timing is done within periods of around 30 seconds, so on the "medium" setting the magnetron will tend to be on for 17 seconds, then off for 13 seconds and so on - for whatever total cooking time you've set the main timer.

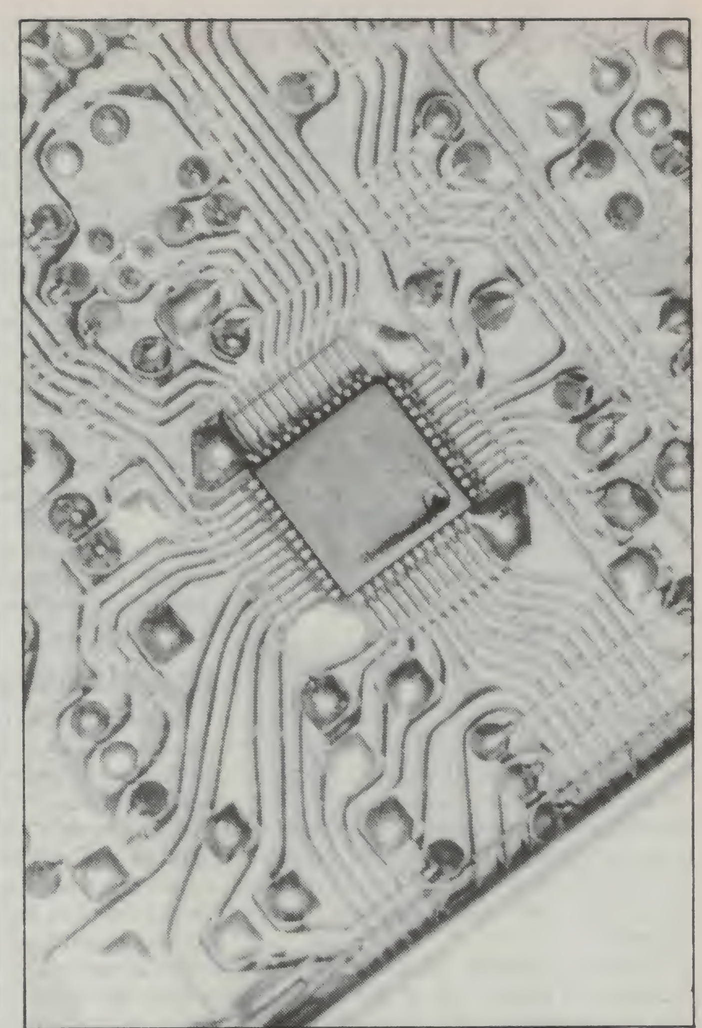
By the way, the effective average power level produced by this on-off control is actually a bit *less* than the timing proportion. This is because the magnetron takes a short while to warm up, each time power is applied. So the "medium" power setting actually produces about 50% average power, and so on.

You're generally not aware of the fact that the magnetron is being turned on and off, because the cooling fan and turntable motors run continuously. At most you may hear a small series of clicks, from the relay used to control the power fed to the magnetron transformer. It's quite elegant.

By the way, this means that with most ovens, there's not really much difference between using say "high" power for 30 seconds, or "medium" power for a minute.



Front and rear views of the front panel of a recent Sharp microwave oven.



On the copper side of the PCB at left, a single SMD integrated circuit performs all control functions.

Enter the micro

Most of the more recent enhancements have been made possible by the addition of a microprocessor controller to the basic microwave oven of Fig.4. This replaces the simple mechanical timing arrangements of basic ovens with a much more flexible electronic circuit, capable of performing not just timing but various other "intelligent" functions.

When microprocessors were first built into microwave ovens about 4-5 years ago, this allowed not just more reliable and flexible control over cooking time and on-off timing for adjustable power level, but the addition of further functions. Examples are functions like providing a digital clock, auto "defrost", and automatic power/cooking time programming on the basis of food type and weight.

A digital clock function is fairly self-explanatory. Most microprocessor-controlled ovens now seem to provide this function - which at least puts the oven's display panel to some use when the oven itself isn't being used.

The auto "defrost" function is actually yet another variant on the on/off control of the magnetron. Here it involves heating the food for a very short time, then stopping and allowing the heat generated within the food (mainly in the outer layers) to travel further inside. Then some more power is applied again for a short time, followed by more "standing", and so on. The nett effect is that the food is gradually warmed up and thawed out, in an evenly distributed fashion.

If full heat were applied continuously instead, the outside of the food would be likely to overheat and be spoilt, while the inside could well remain frozen and uncooked.

Automatic programmed cooking on the basis of keyed-in food type and weight is even more directly a benefit of having a microprocessor controlling the oven. Here the microprocessor is effectively made to run one of a number of power/cooking time programs, stored in its built-in memory ROM. Each program is worked out by home economists in the manufacturer's test kitchens, to produce the optimum results for each different kind of food (beef, lamb, pork, fish, vegetables and so on), and for different quantities.

By the way, these built-in programs are varied from country to country, even for otherwise identical models from the same manufacturer - to suit different national taste preferences. So an oven made for the Japanese domestic market may cook a 2kg chicken rather less "well done" than the same model made for the Australian market, for example. It's quite easy to do this because it's simply a matter of the program information stored inside the microprocessor's ROM.

Automatic cooking

More recently, a further feature has been added to microprocessor controlled microwave ovens: almost fully automatic cooking, using monitoring of the food's condition via feedback from an *absolute humidity sensor*. The oven

is arranged to blow a constant stream of warm air through the food enclosure, and out past the sensor - which monitors its moisture content.

This works as follows. The food is simply placed into the oven, and after shutting the door you press the appropriate button.

The oven then appears to begin cooking, but in reality no power is applied to the magnetron for the first 16 seconds or so. During this period air is simply drawn into the oven, over the food and out past the sensor. As a result, the humidity sensor is "cleaned", and made ready to sense the initial humidity level of the food.

Then power is applied to the magnetron, at a power (timing ratio) level selected by the microprocessor to suit the type of food, and actual cooking begins.

The first effect of the microwave power is to dry the surface of the food, so after short time (typically around 6 seconds) the air passing over the humidity sensor reaches a maximum in terms of dryness (i.e., *minimum* humidity). This level is detected by the microprocessor, and stored in its RAM memory.

Then as cooking proceeds further, moisture is forced out of the food by the heating effect, and the humidity of the air passing over the sensor begins rising.

For each type of food, the microprocessor waits until the humidity rises to a certain pre-determined factor compared with the initial minimum level. This factor is based on actual cooking experience, for that kind of food.

When this level of humidity rise is reached, the microprocessor notes the time taken for this to occur. It then cooks for a further period of time, with both the time and the power level varied according to the length of the first cooking period. The sensor output is not actually used during this second phase of cooking - it is used purely to sense the food's response to the heating during the first phase.

The nett result of this technique is that very close to optimum cooking results are produced consistently, regardless of the inevitable differences in food condition.

Mixed cooking

Another benefit of using a microprocessor controller is that it becomes relatively easy to provide mixed microwave and *convection* cooking.

After "straight" microwave ovens had been on the market for a while, it was found that many potential users found food cooked by microwave to be unappealing - particularly in the visual sense. Since microwave cooking generates heat within the food (albeit near the surface), meat and cakes and other food cooked this way doesn't have a brown, crisp exterior of the kind produced by conventional radiant heating. So manufacturers began adding a so-called "convection" heating feature: the ability to cook or brown the food by blowing extremely hot air over it from a heater element and blower.

Initially the convection and microwave heating facilities were separate, and selected manually by the user as desired. However more recently when ovens were fitted with a microprocessor, it became possible to provide them with automatically *mixed* cooking programs, combining the two types of cooking without hassle.

Again this is done by on/off control, in this case with the microwave and convection heating applied alternately. The magnetron is turned on for say 12 seconds, then the convection heating for 20 seconds, and so on.

This "mixed" cooking effectively provides the most desirable features of both kinds of food heating, and most people seem to find the results very appealing indeed.

Final comments

I think that's a reasonable summary of the current state of microwave oven technology. Hopefully it's given you a good idea of how these appliances work, and what they can currently do.

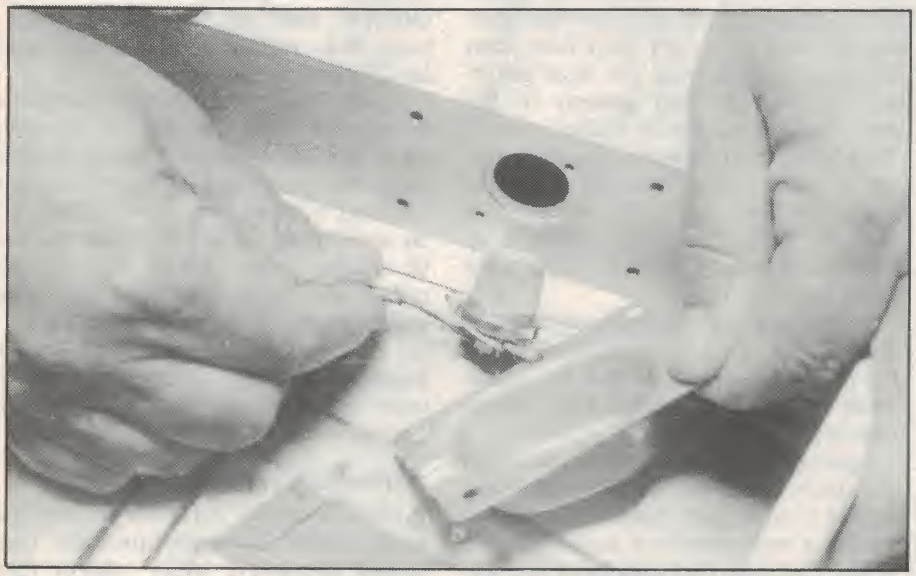
But before closing, I should perhaps make a few final comments.

One thing that puzzled me about these ovens was whether or not running an oven without any food inside, or in other words very little loading (like say drying a damp tea-towel), actually does it any harm. So I made a point of asking the experts about this.

The answer was that very low loading does seem to be undesirable, because very low loading tends to reflect most of the microwave energy back into the magnetron, and can cause it to overheat. The other risk is that with a load having very little moisture content, it may heat up very rapidly and burst into flame. But neither of these is really likely to be a problem if you only do it for a minute or two, and keep a careful eye on things.

How about using metal foil inside a microwave oven? This was a real "no-no" in the early days of these ovens, but foil now seems to be used quite a lot...

Fairly obviously, metal foil will reflect the microwave energy and act as a shield. It can also generate high voltages, and arc over to the oven walls if it swings close to them (within say 10-15mm). But the experts tell me that it's now regarded as quite OK to use it in small amounts, mainly to shield small parts of the food and ensure more even cooking.

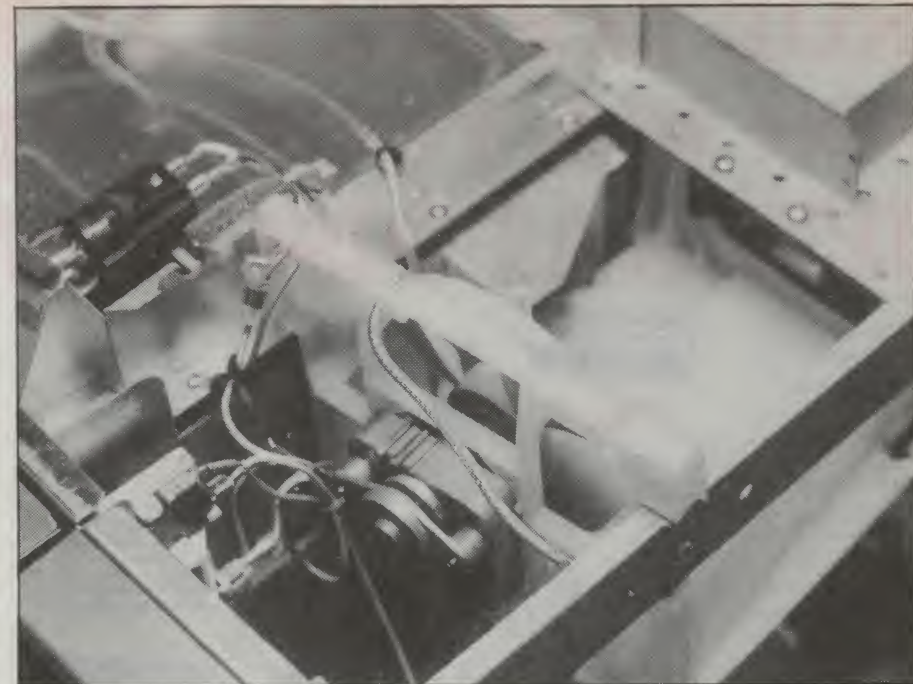


Close-up of a humidity sensor, as used in the latest models featuring automatic sensor cooking. It monitors humidity level in the oven's exhaust air flow. (Courtesy Sharp Corp. Australia)

Small pieces of foil can be wrapped around the "tails" of chops, for example, and the narrow ends of legs of lamb and poultry. This will give more even cooking. But you shouldn't cover more than 25-30% of the food's surface area, and care should be taken to ensure that the foil can't swing near the oven walls. The same tends to apply to metal racks, used to raise meat joints up from the turntable and baking dish for more even cooking.

Do I hear you asking about those new "browning foils"? Yes, I wondered about those too. These are thin paper or plastic coated with metallic oxides, which are supposed to be semi-transparent to microwaves, but get very hot and radiate heat into the food as well. You wrap them around the food to achieve a sort of "poor person's convection heating".

Apparently the experts aren't too sure about these yet. Although they're widely sold, there seems to be a question mark about the possible risk of them overheating and either bursting into flame, or releasing toxic vapours. So perhaps it's best to be a little wary of these, at least for the present.



Top view inside a Sharp oven, showing the cooling fan, door interlock switches at lower left and oven light at upper left. (Courtesy Sharp Corp. Australia)

Finally, a few acknowledgements. I would like to thank Reg Darrough and Mark Hatton of Sharp Corporation of Australia, for their generous help, technical advice and co-operation. Also Jo-Anne McGregor of the same company, for supplying information and pictures of their current models, and Jody Hammond of Panasonic (formerly National) for doing the same. Many thanks!

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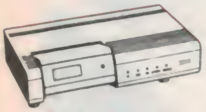

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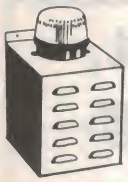

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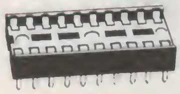

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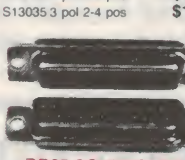

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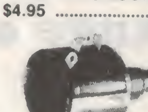

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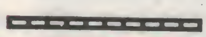

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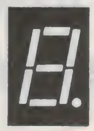

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Cat No.	1-9	10+	100+
Z10190	$1.95	$1.75	$1.50

COMMON ANODE:
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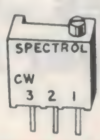

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R14810	50K	$3.50	$3.20
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R14830	200K	$3.50	$3.20
R14840	500K	$3.50	$3.20
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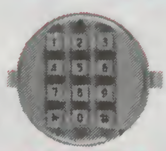

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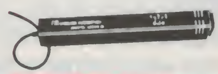

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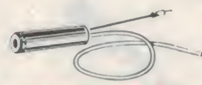

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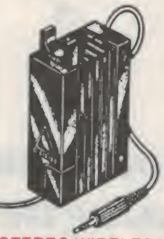

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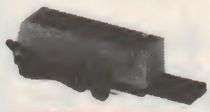

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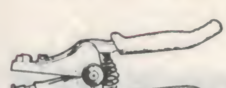

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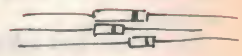

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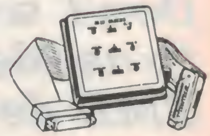

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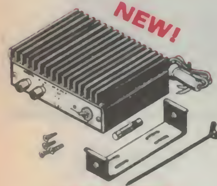

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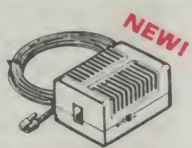

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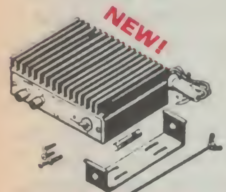

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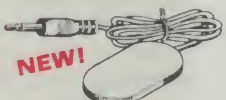

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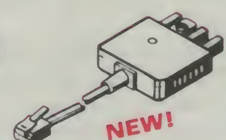

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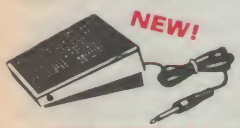

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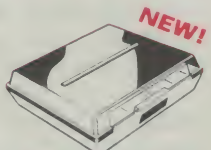

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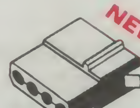

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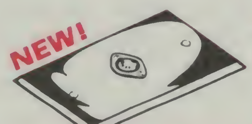

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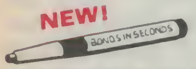

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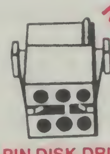

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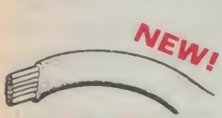

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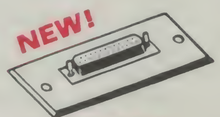

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FORUM

Conducted by Jim Rowe

Hifi amplifier earthing: reader and SAA comments

There's been a lively response to my piece in the February issue, where I said that there was a conflict between safety and performance considerations when it comes to earthing of "double insulated" hifi amplifiers. It's nice to know that this subject can still stir up so much interest!

I guess it really isn't all that surprising that so many people were motivated to respond, because electrical safety is an important topic to all of us. It's an especially sensitive area for any of us making, servicing or selling electrical/–electronic equipment for use by others, where their safety could become our responsibility. And that probably covers quite a few *EA* readers. . .

Most of the responses came from individual readers, although some of these were from people with a great deal of experience in this area. In some cases they were either current members of various electrical safety committees, or had been members of such committees in the past. So they knew what they were talking about.

There was also an official response from the Standards Association of Australia. At the request of Mr Peter Walsh, Group Manager of the SAA's Electrotechnology division, who signed the letter, we published it in the Letters to the Editor columns last month. But more about that later.

One of the letters from individual readers really wasn't a response to my February piece at all. Written by Mr Ian McInnes of Alphington, Victoria, it arrived coincidentally just after the article had gone away to the printers, and some weeks before it was published.

Mr McInnes' letter was really a response to three different other items we've published over the last year or so: two editorials written by the former managing editor, and the hifi amplifier review that Rob Evans and I produced for last December's issue.

An independent consultant with many years' experience in industry and on various SAA committees, Mr McInnes basically wrote because he was concerned at the collective emphasis that we had expressed in these articles, towards earthing as opposed to double insulation. I suspect that when he did get to see my February piece, he would have been even more concerned!

His basic tack seems to be that from a safety point of view, we seem to have discounted the benefits of double insulation, and mistakenly exaggerated the benefits of earthing. Maybe he's right; certainly some of the points that he raises in his letter are interesting and relevant.

For example he points out that with a double insulated appliance, both of the safety barriers are directly under the control of the appliance manufacturer, whereas with an appliance which relies on earthing for one of its barriers, this barrier is subject to all sorts of external factors and therefore not nearly so controlled. Fair enough – particularly when you consider that to a large extent, the manufacturer might well tend to be held responsible in the event of someone being shocked and/or killed.

This distinction between 'safety' and 'functional' earths is an interesting one...

Another point he raises is that quite often, in these days of plastic water pipes, an "earth" connection may be anything but an effective and low resistance connection to true earth. In fact he quotes an example of a radio amateur friend of his, whose earth stake wouldn't pass enough current to heat up a 2kW radiator element – or even to blow a 10A fuse, when it was connected directly to the 240V active and with the surrounding soil well and truly watered!

The obvious implication is that double insulation *per se* provides rather more reliable and dependable protection. And I can't really argue with that.

However the point I was particularly trying to make in the February article is not that double insulation isn't safe – or even perhaps *safer*, compared on an 'exclusive or' basis with earthing – but that when used *without earthing* it can result in poorer performance, when it comes to hifi amplifiers and systems consisting of a number of things connected together (e.g., an amplifier, tuner, turntable, CD player, TV set, VCR and so on).

In other words, I wasn't arguing against the benefits of double insulation, for safety, only against the prohibition on using an earth as well, if this is capable of providing improved performance.

As it happens Ian McInnes does seem to consider this, at least in the context of professional audio equipment. He notes that much of this equipment is either double insulated, or provided with a four-wire system involving both a mains or "safety" or *protective* earth, and a "signal" or *functional* earth, in addition to the mains active and neutral.

This distinction between "safety" and "functional" earths is an interesting one, and I'll come back to it shortly. For the present, though, that seems to be the main points raised by Ian McInnes. Except for his addition of a note of further caution, regarding our use of those very small miniature toggle switches, for power switching on various projects. He points out that although rated for 250V AC, they have very small internal clearances. And since they involve only a single barrier, this means that when

used to switch 240V, they must only be used in equipment with an earthed metal panel. I certainly wouldn't argue with that, either; it sounds very sensible.

But getting back to the subject at hand, another writer who was responding to my article was Mr Lewis Cox of Glen Waverley, Victoria. Mr Cox is a retired engineer of similar long experience, having also been on many industry safety committees.

Basically he seems in reasonable agreement with most of the points I made. He comments that the need for earthing of metal frames on electronic equipment, to avoid undesirable effects of capacitive coupling of AC from the mains (on equipment performance), was debated "loud and long". However he writes that this problem was overcome by the use of a so-called "continuity earth", not to conduct current but to tie the metal to earth potential. This sounds again rather like the "functional" earth referred to by Ian McInnes, and I'll come back to it soon.

Lewis Cox also sheds some helpful light on the reasoning behind the SAA's prohibition against using a 3-wire cable and plug on double-insulated appliances, to provide earthing. He points

Double insulation has actually increased the level of RFI generated by various appliances...

out that the SAA standard wiring connections for 3-pin outlets and plugs was only a *recommendation* in Victoria, until as recently as 1986. Apparently only then did it get the force of law.

Because of this, it was believed that the only way to ensure that the appliance's exposed metalwork *couldn't possibly* become live, due to a wiring error or plug/outlet incompatibility, was to use a two-conductor cable where there simply *was* no conductor directly connected to the exposed metalwork. Needless to say this called for double insulation in the appliance itself, to ensure that the metalwork couldn't become live due to an internal breakdown. Hence the linkup between double insulation and the earthing prohibition.

That sounds reasonable, I admit. At least it explains *why* the prohibition on earthing came into effect, even though it doesn't get around the problem of an amplifier's performance being adversely effected by the lack of an earth.

In fact Mr Cox himself touches on this very point a little later in his letter, by noting that double insulation has actually *increased* the level of RFI generated by various appliances (like motors and fluorescent lamps), because the lack of an earth reference hampers the effectiveness of RFI suppression filters. That's one I hadn't thought of, I admit, but it certainly makes sense. Without an earth, most RFI filters aren't likely to work all that well.

In fact this must mean not only that double-insulated tools and other noise generators will tend to generate more RFI than earthed tools, but also that double-insulated amplifiers and the like will tend to be more prone to interference from it. Which enlarges the scope of my original argument, to be sure.

Mr Cox's suggestion is that to ensure correct operation of equipment like amplifiers, the best plan is to provide it with a separate "equipotential" (=functional?) earth to tie down the case metalwork to earth potential. Which again sounds rather like what I suggested myself, I'm happy to note.

A final point made by Mr Cox is that where 240V power supply is concerned, there's virtually no way to make things totally safe, in all circumstances and for all people. Even core balance relays are not entirely reliable, particularly at the kind of very low current levels (i.e., milliamps) that can cause death. So regardless of what approach you adopt, it's still extremely important to observe all possible safety precautions. I couldn't agree more!

Another reader who makes some very valid comments is Mr W.G. Neumann, of Yeerongpilly in Brisbane. Mr Neumann is very concerned at the fact that when double-insulated audio gear is connected via signal cables to earthed equipment, this automatically earths its metalwork and thereby breaks the "thou shalt not earth" prohibition. Does this make the whole setup unsafe, he asks?

More pertinently, perhaps, he notes that if connecting double-insulated and earthed equipment together breaks the law, this could well invalidate one's house and/or contents insurance. He wonders, for example, what would happen in the event of a fire, or of someone being injured by an electric shock?

A good question – in fact a good pair of questions. My own view is that this interconnection of earthed and double insulated equipment *doesn't* in itself make the setup unsafe, nor does it significantly increase the risk of shock or fire. Hence it *shouldn't* effect one's insurance cover. But if my original thesis was correct, and by doing so you *are* breaking the law, then perhaps your insurance would be invalidated. If that's so, I suspect that possibly hundreds of thousands of us are in that category.

Incidentally Mr Neumann also neatly lobs the ball back into our own court. It turns out that he has built up a number of *EA* projects, including the Teletext Decoder, the Stereo TV Receiver and the Video Enhancer. With regard to the first two of these, he suggests that these fit into *neither* of the official definitions for "double insulated" or "earthed" appliances, because they are fitted with a three-wire mains cord, but this connects only to the frame of the mains transformer – not to the signal common and exposed metalwork like connectors. Exactly what category do these fall into, he asks?

Does connecting double-insulated and earthed equipment together invalidate your insurance?

He points out that a breakdown between the transformer's primary and secondary windings could render the connectors 'live' – so presumably the transformer should be rated for double-insulated use. But if so, presumably its frame shouldn't be earthed, and it shouldn't be fitted with a three-wire cord!

With regard to the Video Enhancer, this unit has an earthed case and the signal connectors are effectively earthed by virtue of being mounted directly on the panel. However this will obviously connect his double-insulated VCR and TV set to earth as soon as they're connected up, presumably breaking the law thereby...

More about that latter point soon, but I suspect there is a fairly simple answer to his query concerning the Teletext Decoder and the Stereo TV Receiver. This is that yes, the transformer should be one effectively rated for double-insulated use – to ensure that there is negligible risk of primary-secondary breakdown. But since the equipment is provided with a three-wire mains cable and three-pin plug, it's obviously an earthed appliance (even though the signal circuitry *isn't* earthed, presumably to avoid earth loop problems).

My understanding is that there's nothing to stop you using a transformer capable of meeting double-insulation specs in an 'earthed' appliance. This is presumably what was done with these projects, with a mains earth used primarily to ensure better shielding between the mains wiring and the signal circuitry.

FORUM

Mr Neumann's parting shot concerns the complications that arise when the IR remote control option to the Teletext Decoder. Apparently this involves adding a small value capacitor between the signal common rail and the chassis. As the latter is 'floating' according to Mr Neumann, he proposes that it could well acquire any 'stray' voltages which are 'strolling by' – so shouldn't the small capacitor be rated at 3750 volts?

I don't know about that. Looking back at the article concerned, it appears to me that the metal case is also earthed, along with the transformer. But even if it weren't, as long as the transformer's frame were earthed, you wouldn't get the usual AC coupled to the chassis via stray capacitance to the transformer frame. So any charge acquired by the chassis should be fairly negligible, I would think. That one seems a bit of a furphy, Mr.Neumann; but you've certainly raised some other interesting points!

Another letter came from Mr Greg Ball, a consulting audio designer of Aspley in Brisbane. Mr Ball notes that the main reason why most modern hifi equipment is double insulated and unearthed is that it is primarily designed for the US market, where two-wire mains outlets still predominate.

Mr Ball also backs up my comments about the need for earthing of much of this equipment, if one is to achieve the best hum and noise performance. He adds that in his opinion the most acceptable and compatible solution to the problem is to use an earthed chassis for the equipment, but with the signal circuitry 'common' isolated from the chassis. This means insulating all input and output connectors, of course. Then to ensure that the complete system formed by all interconnected equipment is ultimately referred back to earth, a 10 ohm 1W resistor is used to tie the signal 'common' back to mains earth *in one unit* (generally the power amplifier).

This is apparently the system used in Mr Ball's locally designed and manufactured 'Eidetic' hifi amplifiers and other equipment, soon to be released on the market. It certainly sounds a sensible solution – assuming all gear you hook together is designed for it.

Mind you, as far as I can see there won't be any real complications if you hook up such an amplifier to a piece of double-insulated equipment. But there's still the possibility that this might break that SAA prohibition on earthing a double-insulated appliance – and possibly invalidate one's insurance...

Another contribution to the discussion came from our old sparring partner Phil Allison, of NiCad battery fame. Phil seeks to correct the impression I might have given in the original article, that the only requirement for double-insulated equipment is insulation capable of withstanding 3750V RMS. He hastens to point out that there's quite a lot more to it, including the use of special insulating materials which won't melt or catch alight, and so on. In fact, the 3750V test is merely a final check, not part of the actual specification. Thanks, Phil, that is an important point I agree.

Mr Allison also makes the point noted by Mr Cox, that the reason for the prohibition on earthing exposed metalwork of a double insulated appliance is because of the risks associated with incorrect mains plug and/or outlet wiring. Better to have no connection to the exposed metalwork at all, so that it can't possibly act as either the source of a shock, or provide an earth path for one.

Right – so now you know or at least I hope you do, because I certainly don't!

Fair enough from the safety point of view, of course – but what about the point I originally raised, about the effect on *performance* – particularly that of hifi gear?

And with that comment, I should perhaps pass back to the official letter from Mr Peter Walsh of the SAA, published in last month's Letters to the Editor columns.

I don't know about you, but I found the letter pretty unsatisfying. It gave me the distinct impression of being written not to offer helpful advice, or to clarify a matter which I'm sure a lot of people find confusing, but primarily to defend the SAA against any perceived or implied criticism.

Certainly it gave a reasonably clear summary of the SAA's definitions regarding 'Class I' (earthed) and 'Class II' (double insulated) safety protection for appliances working at voltages capable of giving shock. It also pointed out that single-layer 'reinforced' insulation has been permitted for Class II classification for more than 30 years, correcting my obviously incorrect impression that it was a more recent development. Fair enough.

But when it comes to the question of why Class II equipment must not be earthed, here's the offered explanation:

The prohibition on the deliberate introduction of an earthing conductor that is not required for electrical safety purposes to Class II equipment is part of the package of requirements that equate the safety levels afforded by Classes I and II.

Right – so now you know. Or at least I hope you do, because I certainly don't. All I get from this rather delightful little example of bureaucratic circumlocution is that 'you mustn't earth a double insulated appliance because we say it isn't necessary for safety, and therefore you mustn't do it'.

It's just as well that other people have offered rather clearer explanations.

Mind you, the letter does clear up the point that there's no prohibition on having amplifiers that fall into the Class I (earthed) category. They can even use Class II or 'double insulated' construction, and still be earthed – providing they aren't marked with the 'double square' symbol:

'Fred is earthing the hifi'

However there is no prohibition in Australian Standards to the use of Class I for amplifiers. Likewise there is no prohibition on the treatment as Class I, i.e., having accessible metal connected to the mains earthing conductor, of an amplifier constructed as Class II but not marked with the 'double square' symbol.

In other words, it's OK to earth your double insulated amplifier, providing you scrape the double square symbol off the back panel. It's the combination of the earth wire and that little symbol that makes the amplifier become dangerous, you see. You can have one or the other, but not both!

All very logical and understandable, isn't it?

But the *piece de resistance* of the SAA's letter comes in the final paragraph:

As the options available to manufacturers and purchasers of audio systems are clearly covered in the applicable standards there seems to be no need for action by SAA and State Regulatory Authorities as suggested in your article. If your aim is to have amplifiers manufactured with a mains earth connection, perhaps you should encourage manufacturers and suppliers to provide them, as current Australian Standards do allow for such equipment.

Ah – everything's fine, no problems. The Standards are perfectly clear, and cover all situations. Presumably we can all go back to sleep, right?

The main problem with this rather glib SAA put-down is that it avoids just about all of the points I raised in the original piece, about the way amplifier and system *performance* is affected by not having a proper earth. At the same time, it raises a few very moot points of its own.

For example what happens when you connect a Class II CD player, VCR or TV set to an earthed Class I amplifier. Do you have to go around methodically scraping off the Class II appliances' double square symbols, so they don't suddenly become dangerous?

This is not an idle or fatuous question, fellas – in case you haven't noticed, people are connecting this sort of equipment together all the time nowadays!

As for everything being covered and made clear in the relevant SAA specs, that may be fine for manufacturers and suppliers. But how many people who walk into the average discount store to buy a hifi amplifier, a CD player or the like are going to know what is in the SAA specs? For that matter, how many sales assistants in these stores will know what's in them, either?

Even to suggest that I should try convincing the hifi equipment manufacturers to earth their products seems to show that the SAA is either ignorant of the real market situation with regard to these products, or is displaying a remarkable level of cynicism.

The fact is, of course, that at least 95% of this equipment (like most of our other consumer appliances) is made in either Japan, Taiwan or the other big Asian manufacturing export countries. And to these manufacturers, the Australian market is a tiny appendage on their real markets in North America and Europe.

As Greg Ball notes, they've adopted the double-insulated approach to simplify getting their products passed by the safety authorities – particularly in those markets. The idea that they'd be the least interested in treating our market differently, simply to allow better performance, is quite laughable.

You may have to scrape off that symbol...

In fact when I asked a spokesman for one of the hifi equipment importers why their double-insulated amplifiers had no provision for earthing to prevent hum, his reply was 'Oh, we can't do that – the SAA wouldn't let us!' So much for them being interested in solving the problem – and so much for the SAA regulations being clear to all concerned.

Well then, where does all this leave us? Frankly I found the whole tone of the official SAA letter so unhelpful that I took the opportunity to discuss the matter unofficially, with a very experienced electrical safety engineer, who happens to be on a number of SAA committees.

No, I'm not going to give his name, in case I've misunderstood him, and/or extrapolate wrongly from what he said.

Anyhow, this gentleman was in fact considerably more helpful than the SAA letter. And here's where we get back to that distinction noted earlier, between a 'protective' earth and a 'functional' earth.

He explained that the SAA's Class I (earthed) and Class II double insulated) categories are basically standards which must be met by any manufacturer or importer offering equipment for sale. And to meet the requirements for Class II (double insulation), the exposed metalwork of the equipment must not have any provision for the connection of a *protective earth*. That is, an earth designed to form part of the equipment's safety arrangements.

But there's no reason why it can't be provided with a means of connecting this metalwork (and the internal circuitry inside the double-insulated protective barrier) to a *functional* earth.

And what exactly is a functional earth, as opposed to a safety earth? When I asked this, the gentleman concerned first replied that it would normally be a common 'equipotential' line, shared by all of the pieces of equipment to be interconnected. A signal common, in fact.

But was it permissible to connect this common equipotential line to 'real' earth, if this gave better results in terms of performance?

At first my adviser suggested this would never be necessary, because simply tying all the equipment metalwork together should get around all of the problems. But when I pressed him, pointing out that some hifi systems really *did* seem to need tying down to 'real' earth, in order to minimise hum and RFI, he reluctantly admitted that yes, he believed that would be allowed. Provided that this earth connection was *external* to the equipment, as this would not lead to a reduction in the safety level.

In other words, it looks as if you actually CAN connect the metalwork and signal circuitry of your double-insulated audio or other gear to earth, without breaking the law, providing it's only to a *functional* earth. In other words, providing you're only doing it to improve its performance – not to improve its safety.

Whether or not you have to scrape off the little 'double squares' symbol from all of the double insulated gear when you do it, or stick pieces of masking tape over them, I'm still not sure. And what happens when the 'functional' earth also happens to be the protective earth connection for a piece of Class I gear, I'm also not sure. But I suspect it may be allowable, after all.

It all sounds a bit like the old religious joke that it was alright to do all sorts of naughty things, providing you made sure you didn't enjoy it!

Of course if you do elect to connect your equipment to what the SAA is pleased to call a 'functional' earth, to improve its performance, you do have to make sure it really is connected to a true earth. If you make a mistake and connect it to something that could become 'live', the results could be tragic.

Compact Disc Reviews

by RON COOPER

DVORAK/SCHUMANN

Piano Quintets
Jan Panenka
Smetana Quartet
Denon 33CO-1329
Playing Time: 68 min 12 sec

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

Here is another stunning performance by the Smetana Quartet of Chamber music, on the Denon label. The Dvorak work was written in 1887, some 15 years after he had written his first piano quintet with which he was extremely dissatisfied and never had published.

This work begins with a magnificent solo cello and has a wealth of Bohemian colour. It is acknowledged as a masterpiece of nationalistic chamber music. The Schumann quintet in E flat Op.44 was written in 1842 along with four other chamber works during that year. Although I was not familiar with this work I found it had instant appeal with its rollicking tempos and sheer brilliance by the performers. As with most chamber music there are many exposed parts for each instrument even when its in the form of an accompaniment. with only five performers each one is virtually under an audio microscope, more so with the non existent background noise of a CD. The result here, I feel is just perfection.

The recording itself, likewise, is magnificent with very good balance between all players with perhaps just a hint of over miking (I am now being very critical). Really though, a first class disc.

BERLIOZ

Symphonie Fantastique
London Symphony Orchestra
Conducted by Richard Williams
IMP PCD 870
Playing Time: 57 min 51 sec

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

Written around 1803, this work was a bold step in symphonic history. Beethoven had just completed his Eroica (No.3 out of 9), and most other composers were still writing in the style of Mozart and Haydn.

But this was the beginning of many romantic symphonies, far removed from the sound of Mozart and Haydn. This work I always find enchanting, although 'sinister' is probably a good word for it, with its haunting spacious sounds. Just the stuff good hifi equipment thrives on!

This budget disc is recorded very well, with excellent bottom end. But I feel it's recorded from a little too far back, with the inherent extra acoustic reverberation that this brings. For example, you do not hear the sinister bass trombone in the 4th movement as on some other recordings. It is not quite up to the Decca version with Charles Dutoit that I have previously reviewed.

Nonetheless, overall a great performance from this new conductor, with very sensitive solo playing. And like other discs on the IMP label I have reviewed, very good value for money, with long playing time and excellent cover notes.

BEETHOVEN

Piano Concertos 3&4: Cristina Ortiz,
City of London Sinfonia
Conducted by Richard Hickox
IMP PCD 879
Playing Time: 66 min 47 sec

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

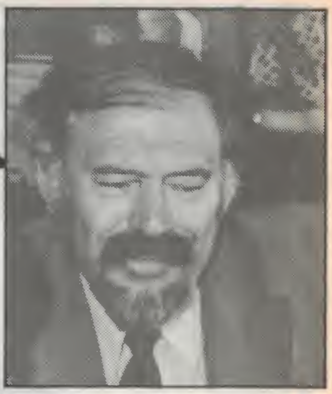
Here is another fine disc from the budget IMP label, which features two popular Beethoven concertos. These concertos were written around the time from 1800 when Beethoven's deafness was starting to become evident. Yet when listening to these, and all his later compositions it seems unbelievable that such sound enjoyment could flow from the pen of a person so afflicted.

This is a new digital recording, skilfully performed with plenty of feeling – although I personally prefer the Ashkenazy version and particularly the Van Cliburn version of the 4th with its slightly slower yet crisper sound (albeit on an older recording).

From a technical viewpoint the recording is clean and clear but with some hardness to the strings. The acoustics are quite good but the tonal balance seems to have a midrange, slightly hollow sound which gives extra clarity for the woodwinds at the expense of overall depth. Balance between piano and orchestra is first class and despite the shortcomings it still represents excellent value for money as it is not a rehash of an older inferior recording, as sometimes presented on budget labels.

Frankly Frank

Musings on matters electronic by FRANK LINTON-SIMPKINS



Simulation and reality

Once the computer was established as a tool of industry, the engineers started to think of using it to simulate equipment under test. Firstly, they tried to use digital machines in the way that they had used analogs, then they moved to hybrids with the digitals providing the logic while the analog modelled the equipment.

The way of the future had come, and our American cousins did their normal thing by going right over the top for newness – without being as cautious as perhaps they should have been. Nowhere has this been more apparent than in the defence area.

Take the Armoured Combat Earthmover, or battlefield bulldozer. This was a 1958 requirement, specified by the US army to be able to swim, resist anti-bulldozer weapons and to be capable of being air lifted into its workplace. Just the thing, or so one would think for Tasmanian timber chopping companies.

Just 24 years later in 1982 the US Army got its first superdozers with the placement of an order worth just under $US20 million. That is, the order was placed in 1982, and by 1985 the first machines were actually delivered.

...the hatch over the driver was too heavy to be lifted without a small crane...

This was the first time that the machines were ever asked to do a test in the field, as opposed to a computer simulated one. The field test revealed a few problems that hadn't shown up on the computer model. The transmission cracked in the field, the hatch over the driver was too heavy to be lifted without a small crane and it was reported that working on the engine could endanger the operator's life if he didn't wear a respirator and breathing support equipment.

The first production machines will be delivered to the US Army just 30 years after the requirement was issued, and a major redesign of certain parts has had to be done after field testing.

After other testing of certain Cruise missiles, they worked superbly well under simulation but couldn't track across wide flat plains similar to those of Russia, in field testing. Simulation and modelling has also shown that the US MX missiles work well, but they can't be tested realistically in the field and one wonders rather if the same thing will apply as did with the Cruise Missiles and the Bulldozers, bearing in mind that the MX is vastly more complicated than the Superdozer.

The US Army has a new armoured personnel carrier that will almost certainly be sold to Australia as well. This has never been tried with live ammunition, but it has shown excellent survival against the simulated attacks in computer trials.

There are serious problems in not using real field tests. The British found out in the Falklands that the clothes issued to UK sailors easily caught fire and burned. The worst damage to a UK destroyer from the French made Exocet missile, happened when one failed to explode after hitting a ship. But its exhaust flames ignited carpets and curtains, and eventually the aluminium superstructure of the ship itself. Also the UK battle computers had Exocets recorded as friendly missiles, not to be attacked.

The US has become so certain of its simulation industry that it no longer runs live tests to validate its models. What happens is that the engineers run what are called sensitivity analyses. This may work, but it may not.

No modelling of battle conditions in UK ships showed up the danger of the curtains and the carpets, and the burning of the superstructure itself never was seen by the model as likely. Men died as a result, and valuable military assets were lost.

But possibly the worst discrepancy between simulated attack results and what happens in the field can be shown by the use of the weapon called 'Stinger' in Afghanistan, by the rebels against Russian forces. Stinger is a 'sure kill' heat seeking, man portable and single man operated anti-aircraft weapon. It is intended to be used by normal troops in the field against ground attack aircraft. In computer simulated testing Stinger had a 100% kill rate.

In the mountains and used by Pathan troops against Russian aircraft, its kill rate has been terrible. It simply doesn't work too well in the field. According to one Afghan report, of 12 missiles fired 11 failed in some way, and the other one ran out of fuel before hitting the target!

...the UK battle computers had Exocets recorded as friendly missiles, not to be attacked!

The problem is that the weapon, which was intended for use by relatively untrained troops, actually requires very *highly* trained troops to use effectively. In the field the kill rate even using such troops is poor against target drones, not to mention skilfully flown enemy aircraft.

Another use of simulation techniques that hasn't panned out for the US is in training of aircrew. After training on the US Navy's simulator, pilots are grounded temporarily because the simulation is so unreal. Apparently Flight Simulator running on your PC is about as like real flying as the US Navy simulation.

Perhaps it might be better if we decided not to have any more real wars, because nothing seems to work as designed anymore (except spears). Either that, or we could have only simulated wars, where everything works perfectly but no-one gets killed!

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2A	S-4467
3A	S-4469
5A	S-4471
7.5A	S-4473
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20A	S-4479
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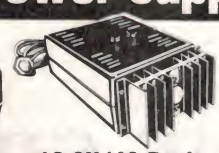

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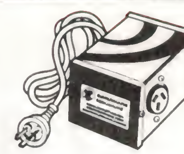

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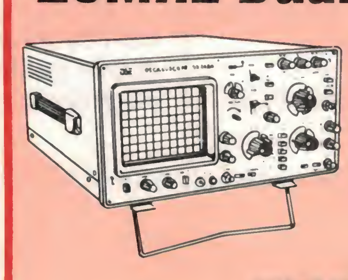

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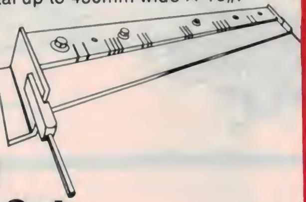

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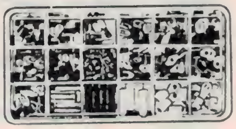

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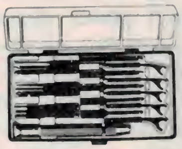

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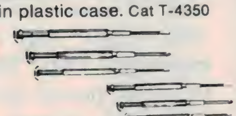

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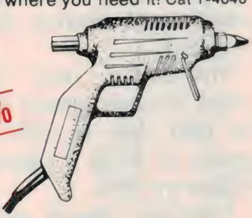

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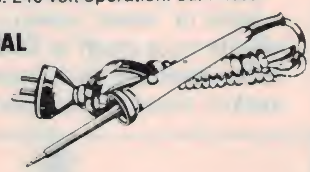

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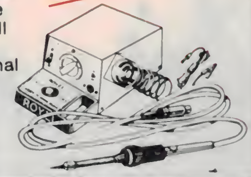

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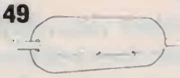

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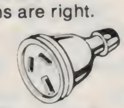

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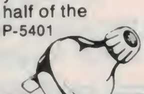

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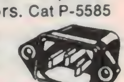

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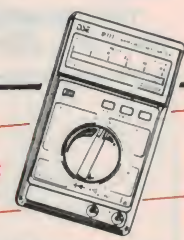

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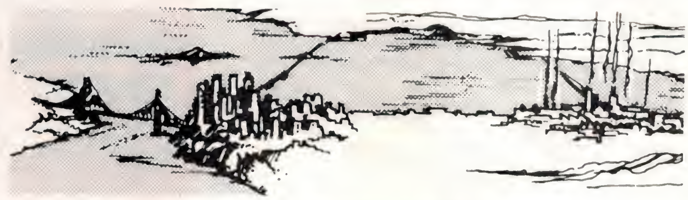
Silicon Valley NEWSLETTER . . .



AMD to build $US95 million chip research centre

In a major effort to catch up in critical areas of chip technology, Advanced Micro Devices is planning to build a new chip research centre that may cost up to $US95 million by the time of its completion in 1989. The plans were announced by AMD chairman Jerry Sanders during an interview on a Silicon Valley television program.

The facility will include a huge 35,000-square-foot class-one cleanroom, that will allow for just *one* potentially contaminating particle for every one billion particles of air.

At the facility, AMD researchers will be developing designs and processes for advanced sub-micron circuits. Presumably the research will focus on CMOS-based processes, an area in which AMD still lacks many rivals in the semiconductor industry.

According to AMD spokesman John Greenagel, the establishment of a research centre is critical to a company like AMD, which ranks as the fifth largest US chip maker with more than $US1 billion in sales. 'The whole thing is technology driven. By all accounts, where US manufacturers lag behind their foreign counterparts is in manufacturing. You have to push the technology smaller.'

AMD becomes the second major Silicon Valley chip maker to unveil plans for a major research centre in Silicon Valley. Last Fall, Intel began building a $US95 million research facility in Santa Clara that will have some 20,000-square-foot worth of cleanroom space.

Back in 1985, National Semiconductor also planned to build a $75 million research facility. Although it has completed construction of the huge facility, the two-year recession forced the company to abandon its plans to complete the project. But according to a National vice president Linda Baker, National is once again proceeding with its plans for the facility. Work has already begun on staffing and equipping the facility which may become operational as early as this summer. If so, National will be the first of the valley's Big Three chip makers with a chip research facility.

The moves by National, Intel and AMD also follow the establishment of the industry-wide Sematech research consortium which recently announced it will be setting up shop in Austin, Texas.

Construction begins on Intel's new facility

Big growth seen for Smart power market

Sales of 'smart' power devices could balloon to as much as $US1.2 billion by 1992, according to a recently released market report from Electronic Trend Publications in Saratoga, California.

The driving force behind the market for smart power devices which combine power control functions with semiconductor logic, is the rapidly increasing number of applications in the areas of consumer, automotive, office automation, telecommunications, power supply and industrial electronics.

Motion control in stepper and brushless DC motors, for example, is now offering vast new application opportunities to enhance product features, improve performance and reliability, while reducing component count and cost.

'Smart power devices will revolutionise electronic component design' commented ETP president Gene Selven. 'It is estimated that as much as one-third of electronic equipment space is taken up by power supply equipment such as wires, cabinetry, cooling, etc. A major benefit of smart power is the replacement of many discrete components with fewer chips, and often with a single monolithic chip. The greatest potential for smart power devices is in displacing traditional discrete designs with advanced IC technology. 'A variety of high-voltage monolithic ICs will simplify design tasks by taking over the roles of hybrid circuits which often require large numbers of discrete components,' Selven said.

Worldwide, only $US188 million worth of smart power devices were sold in 1986. But by 1992, that will have grown to $US1.2 billion and even $2.4 billion by 1995.

Currently, already more than 40 companies are marketing smart power components.

Apple chips?

Will Apple become a chip manufacturer? Possibly! The Cupertino company has set up a task force that is charged with deciding where and how Apple will be getting the custom processors and other ASIC chips that power its line of personal computers and peripherals.

Apple has been an aggressive user of state-of-the-art ASIC circuits, most of which have been produced by VLSI Technology and NEC. But in a recent

speech, Apple's senior technology analyst Al Alcorn said Apple is looking for different ways to secure a steady stream of leading edge ASICs, even if it means making the chips itself. Alcorn added, however, that Apple would prefer not having to go into the chip production business itself because of the cost involved and the difficulty of trying to keep up with the rapid technological developments in the semiconductor industry.

At this point, he said, Apple is not looking to buy any chip operation. Some industry observers have speculated that Apple may be using the threat of producing its own ASIC chips as a means of securing a better deal with its current chip suppliers.

Finally NeXT?

According to the latest reports surrounding the new company of Steve Jobs, NeXT has already begun limited production of its new computer at the company's headquarters in Fremont.

The introduction of the NeXT system, already a year later than expected, is now expected within months.

The system should be a technological jewel, considering Jobs' reputation for perfection and use of the latest technology. For one, rumours have it that Jobs may be using revolutionary Digital Audio Tape (DAT) cartridges, instead of disk drives, as the main storage medium for his systems. DAT has been hailed as a potentially formidable new storage medium, as the tapes can hold vast amounts of data on a small standard cassette.

H-P water test

It's the stuff television commercials are made with.

Back in August last year, retired aerospace engineer Alen Tompkins' home in Oregon was broken into and along with the other valuables, the thief took his H-P laser printer.

Earlier this year, Tompkins' neighbour went fishing in a nearby lake, and hooked the printer – which had been sitting on the bottom under five feet of muddy water. Tompkins of course had already purchased a new printer, which he uses to design ship hulls. Curious to see if his old printer would still work, he hosed off the mud inside and out, and dried the machine by baking it in the oven for ten hours.

He then took the printer to a nearby H-P facility for a test. And sure enough, the machine worked as before, except that it seemed a bit noisier than Tompkins could remember... EA

The Serviceman

A really elusive fault in a Philips K11 CTV

I was almost going to call my first story this month, 'The Case of the Phrustrating Philips', but that is a bit corny. Still, it is the story of one of the most frustrating jobs I have ever had. Not only was it difficult and expensive, but when it was all over I still didn't know what the trouble was!

The 22" Philips set arrived at the workshop with a note saying 'It don't go Mate!! Canya fix it?' I've never been able to resist the challenge, so I wrote back 'Yeah! No risk!' but very soon began to regret my impetuosity.

The set was fitted with a K11 chassis. This is very similar to the original Philips K9 chassis, but at least in my area is nowhere near as common as the original. Still, I have a good range of spares for both models, so I didn't anticipate any real problems.

To begin with, the set was 'hiccupping' when switched on. In K9's and K11's this can be caused by a number of troubles, but is usually one of two faults. One is a shorted or leaky line output transistor; the other is a dodgy tripler.

The transistor can usually be tested by measuring the resistance between its collector and ground. The transistor is easy to get at, and for this test it is not necessary to disconnect any of the transistor's leads. I always consider anything less than 200k ohms to ground as doubtful, and remove the transistor for more exacting tests.

In this case the resistance to ground appeared to be in the megohm range so I went on to look elsewhere – namely, the tripler. Unfortunately, unhooking the tripler didn't do any good either. I still had a hiccupping power supply.

The last test before one begins tearing one's hair out is to pull plug M3 on the line output board. This isolates the power supply from the line output stage. If the 155V rail then comes up, it's a sure sign that something is wrong with the output stage.

This test was inconclusive, because although the supply was still hiccupping, the 155V rail was now pulsing around the 80V – 100V mark whereas it had been hovering around 10V before the plug was removed. So, it looked as though we had two faults, one in the power supply and one in the line stage.

It seemed that the line stage fault was leakage to ground, although testing with a multimeter could not detect anything wrong. But having been caught recently with breakdowns which only occurred under load, I resolved to test the transistor and any bypass caps I could find, at a higher voltage than the simple multimeter could provide.

First, I removed the 2SD350 line output transistor and connected it across a 30V bench power supply, in series with my multimeter set to the 500mA range.

The three volt battery in the ohmmeter could only push one or two microamps through the circuit, and as a result read in the megohm range. But on ten times that voltage things began to happen. In fact, the milliammeter showed twenty-odd milliamps of leakage at thirty volts. It would probably run to amps of leakage at 155V. So I fitted a new transistor.

I restored plug M3 and switched on. I was half hoping that the set would start working at once. But the now familiar 'tick, tick, tick' of a hiccupping supply soon told me that I still had problems. And a moment later, I knew they were *real* problems.

As I stood looking at the component side of the line output board, I noticed a ring of bubbles appear around the outside of the line transformer overwind. The bubbles turned black, then started to smoke, I switched off in a hurry.

The only thing I could think of that would make a transformer smoke was a short on its output, in this case the tripler. But the tripler was still disconnected, after the earlier test! So it had to be shorted turns in the transformer. This job was not looking very promising . . .

At this point, the customer was faced with the considerable cost of a new transformer and the moderate cost of the 2SD350, provided that no other faults turned up. In fact, I was still dubious about the tripler, and fairly sure that there was something wrong with the power supply. So I didn't feel like going ahead with any more work until I had discussed it with him.

Before I rang the owner, I put my emission tester on the tube and got a reading of 90% on all three guns. The tester is not infallible, but I have found it fairly reliable. In this case 90% was remarkable for such an old tube, and it was also surprising to find all three guns within one percent of each other. I was prepared to bet a dud diode to a duck dinner that the set had been showing a first class picture before it failed.

When I reported to the owner with the bad news, I half expected him to say 'scrap it'. But he didn't. He groaned, then suggested that at least, the repair would be cheaper than a new set. The only consolation I could give him was the good news about his picture tube.

At this point he asked me if the total cost was likely to exceed $200. Although I had not checked any prices, I felt fairly confident that even the worst case should not cost more than about $100 for the parts so I agreed not to go over this limit without phoning him first.

So I ordered a new transformer and restocked with a batch of triplers, just in case.

The transformer duly arrived and was fitted with only a little difficulty. I hoped that the next switch-on would produce normal operation, but my earlier fears were confirmed. The supply was still hiccupping.

The tripler was the only thing nor-

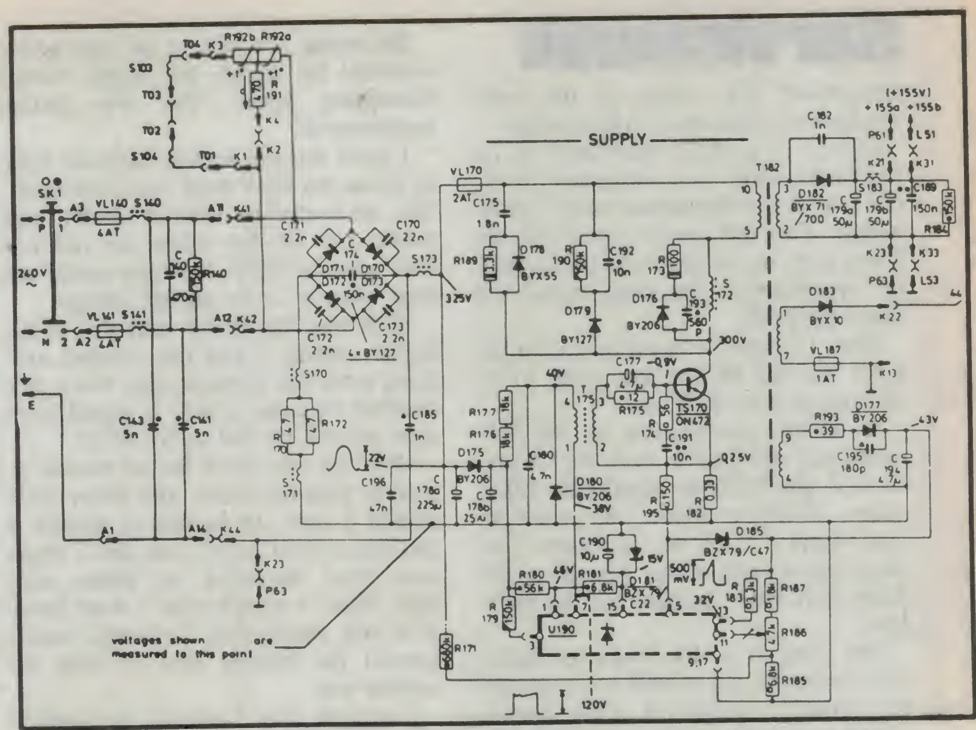
mally likely to cause this trouble, that had not already been replaced. Using a high voltage probe, I looked for some kind of output from the tripler. Although the supply was still hiccupping, the hiccups should be reflected in the EHT if the tripler was OK.

In this case there was no sign of life, so out came the tripler and in went a new one. But all to no avail – the power was still hiccupping happily, although we now had a pulsating 8kV EHT supply.

At this point I had to take stock of what had been done, and what was likely to still be needed. The customer's parts bill was now over the $100 mark. If the power supply needed major parts too, there'd be nothing left for me out of the owner's limit. I had to make up my mind soon or face the prospect of a big job with no profit.

Among my Philips spares are two complete power supply boards from K9 chassis. These differ slightly from the K11 board, in that there is an extra socket on the latter board, and all are positioned differently. However, it is possible to interchange these boards for test purposes, and this I proceeded to do.

With a K9 power board fitted, the set came to life and ran perfectly. A touch up to the focus and the grey scale and the set was displaying a picture as good as any Philips I've ever seen. So, the problem had to be a power supply one and should not be too hard to fix. The

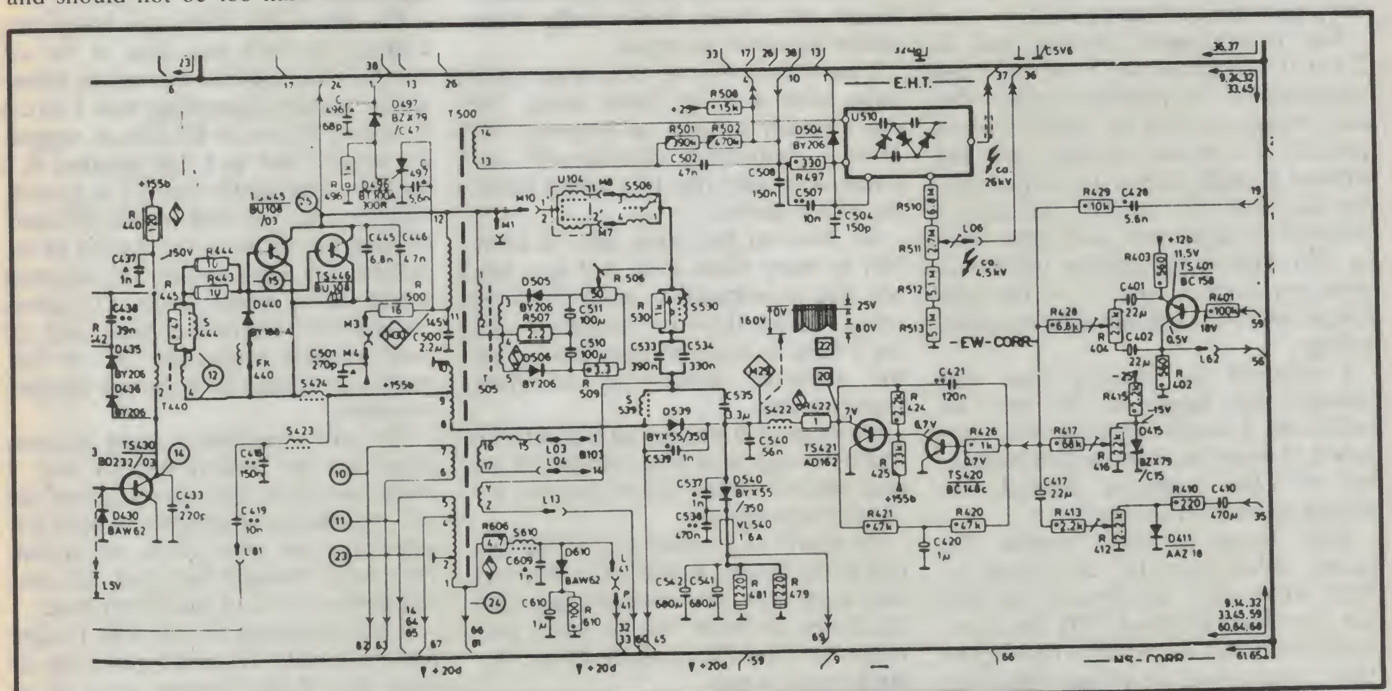


The power supply section of the Philips K9, which is very similar to the K11 model. The U190 control module is at lower right.

big question was, would it be *expensive* to fix?

A common cause of trouble with K9 and K11 power supplies is a failure in the control module U190. Replacement modules are now a very expensive item, but faulty ones can often be repaired at a considerable saving in cost. In this case I swapped the U190 from the K11 board into the K9, half expecting the K9 board to begin playing up. But it didn't. So the trouble wasn't in the module.

One big advantage of having a spare board on hand is that comparative tests are easy. A suspect component on the faulty board can be compared with the same component on the good board, using nothing more than a common multimeter. There is no need to remove



The horizontal output and EHT section of the K9, again very similar to the K11 model discussed in the story. The EHT tripler is U510, at upper right.

components for testing as the same conditions should apply in both cases.

Only if an anomaly does show up on the faulty board is it necessary to lift one end of the component under examination. This will usually point out the faulty part, but in the worst case a similar operation on the good board will prove the point.

Well, I've always found that so in the past, but this Philips was going to be the exception to the rule.

A minute examination of the K11 board and comparison with the K9 unit showed absolutely no significant differences. Every resistance measurement was within 1% of its equivalent, and there was no sign of any damage or dry joints that might account for the problem.

One thing that this simple comparative resistance check will not reveal is the turnover voltage of zener diodes, and this is an important parameter in most power supplies. In this case the easiest way to check the zeners was to swap them over from one board to the other.

But even with all the diodes changed over, the faulty board still hiccupped, while the good board worked perfectly!

By this time I was tearing my hair out in desperation. I had spent quite a few hours on this set and seemed to be nowhere near solving the problem. All I could think of now was to bench-test the supply using a dummy load.

The recommended dummy load is 2 × 100 watt lamps and I soon had this connected to the doubtful supply. The only trouble was that the supply worked perfectly. It started instantly and ran without a single hiccup. Its output voltage was very high, at 180V, but this responded to adjustment and came back to 155V without the slightest trouble. It even ran perfectly into 3 × 100 watt lamps, with only a minor drop in output voltage.

I removed the dummy load and returned the supply to the set. At switch on, I would not have been surprised to hear the now familiar ticking, but no! The (expletive deleted) set started up and worked perfectly.

Well, almost perfectly, because the picture didn't quite fill the screen. A check of the HT rail showed that this was now down to about 130V but there was no difficulty in getting it back up to 155V, whereupon the picture filled the screen and the set worked like a new one.

But would you believe the next time I switched the set on, the supply started hiccupping again. This was getting monotonous!

I reset the rail voltage adjuster back to about the 130V mark and tried again. The set started up without trouble, and would run all day when the rail was then reset to 155V. It simply would not start when set to the higher voltage.

Then one day it did start up, at the higher setting. I had not touched anything since the previous test, but it just decided to come good. It would even start up with the rail set to 165V!

Over the next week the set started up several hundred times and never once missed a beat. It seemed as though it had never been faulty, and that I might have been imagining the whole sorry saga. Now, a month after it went home it is still performing flawlessly, and I haven't the faintest idea of what the trouble was.

I suppose that I should be thankful that the set is fixed, but it leaves me feeling frustrated and unfulfilled. If I don't learn something from these difficult jobs, I have no experience to draw on the next time I meet the same fault. But then, perhaps I'll get lucky and never see this one again!

Changing the subject from difficult sets, servicing would be a wonderful job if it wasn't for the customers. We've written along these lines many times before, but usually with respect to silly or stupid customers. This time I want to sound off about some really nasty and/or inconsiderate types.

I am writing this on a Saturday afternoon after a rather latish lunch. We don't usually eat late on Saturday, but today a particularly objectionable customer demanded that I fix his set before the footie started.

He lives on the other side of town. Not so many miles away, but in a suburb that is awkward to reach from my camp. To get there on Saturday morning I have to battle my way through all the underage soccer and schoolboy hockey teams.

His repair job was not all that difficult and took very little time, but he hit the roof when I added $10 to the bill for out of hours service.

He wasn't at all interested in the fact that I had already worked over 40 hours this week. He gets overtime for anything over 36 hours, but he wasn't prepared to concede anything to me for much longer hours.

Then there was a call from Mrs Nasty last Wednesday morning. She called at 11.45 and demanded that I come straight away to fix her set. It wasn't working and she wanted to watch the midday show.

Firstly, I told her that I was about to go to lunch, and wouldn't be available for anybody until 1pm. Secondly, I had two days' work on hand in the workshop, as well as calls that had been waiting two days already. I wasn't going to break faith with those customers to do work out of turn. Besides, I was hungry and wanted my lunch.

The wires between Mrs Nasty and my workshop started to smoke. She was absolutely furious, and told me so in no uncertain terms.I kept my cool and during a break in the tirade suggested that she call someone else to see if they could come sooner.

Would you believe, she told me she had already rung eight other technicians and none of them would come until late next week. 'What's wrong with you people?' she said. 'Isn't my money good enough?' No lady, it's not your money that's bad, just your temper and your unbelievable selfishness.

Then there was the highly placed Public Servant, a $40,000 a year man with a lovely home and the oldest of old Kriesler colour TV's. It stopped working and I was called in to fix it. It was a simple case of chopper failure and the usual treatment restored it to normal. At least Mrs Public Servant and I both thought it was normal again, given the age of the set.

But when His Nibbs got home that evening, he took one look at the set and blew his top. He was on the phone within minutes demanding that I return to restore the set to his idea of normal. He insisted that as I had repaired it, I was also responsible for (1) a greyish, weak picture, (2) weak colour, (3) small convergence errors in the corners of the picture, (4) weak sound, (5) distorted sound, (6) a broken knob, (7) screws missing from the cabinet back, and (8) loose antenna connection. All of this, mark you, caused by a shorted chopper transistor.

The only complaint I could acknowledge was the broken antenna lead. I could have done that when I moved the set. No amount of argument would placate him, not even when my picture tube tester showed him that the tube was down to 25% of normal efficiency.

It was beginning to look like I might have to rebuild, or even replace his set when Mrs Public Servant stood up to him for probably the first time in their married life. She told him off in no un-

certain manner and let him know that he had no right to expect new set performance from a 12 year model.

His parting shot was 'I'll never have you here again!' Mine was 'I wouldn't come if you paid me!'

The phone rang one Sunday evening and a voice declaimed 'You fixed my television three years ago. You're the only technician that has touched it since it was new!' 'Well, so what?' I thought. 'I've fixed a lot of TV's before and since'.

It was his next blast that floored me.

'Why did you change the chassis over?' he said angrily. 'I recorded the serial number when I bought the set, and now it has a different number.'

Now I've been accused of a lot of things in my time, but chassis changing is not one of them. Even so, it does not seem to be all that earth-shattering, so long as the customer has an identical chassis, of the same model and vintage, and in good working order. Still, he deserved an explanation and I dug into my records to give him one.

For many years now I have kept a card index of all my customers and their equipment. The records include make, model, serial number, date, job number and brief outline of the fault. This is often helpful in establishing that the last repair was really two years ago and not just two months back. This time it was going to be just as valuable.

My records for this particular customer showed that I had seen his set twice. The first time was three years ago, and then about twelve months ago. (He had forgotten about the last one.) And the serial number that I had recorded on both occasions was MB 965 0437.

I checked with him that that was indeed the number on his set then asked what number he had recorded when he bought the set. Would you believe, he had written down MB 965 37.

When I pointed out that this was almost the same number, but with the digits 04 missing, and suggested that he might have written them down wrongly all those years ago, he became quite indignant and said that he'd '... get to the bottom of this, one way or another.'

I've yet to learn what 'getting to the bottom of it' means, but I probably will because now his set has broken down again and he wants me to fix it!

As I said at the beginning, TV repairing would be quite a good job if it were not for the customers. Next time you hold out your hand for your overtime, or your 17½% leave loading, spare a thought for this sorry lot — the self employed domestic appliance serviceman.

Just before I end this month, one of my colleagues in Victoria has made what seems to be a very worthwhile suggestion. This is that we service people could start up a fax users group, to exchange service information, circuits and information on spare parts availability.

I'd be interested to hear readers comments on this. What do you think?

TETIA Fault of the Month

Toshiba C810

Symptom: No colour. Has been intermittent, but now has failed completely.

Cure: Dry joints on plug-in chroma board. This is a double sided board, and the faulty joint is more often than not on the top surface.

This information is supplied by courtesy of the Tasmanian branch of The Electronic Technicians' Institute of Australia. Contributions should be sent to J. Lawler, 16 Adina St, Geilston Bay, Tas 7015.

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NOISE: 116 dB below full output (flat, 20KHz bandwidth).
2nd HARMONIC DISTORTION: 0.001% at 1 KHz (0.0007% on Prototypes) at 100W ouput using a + =56V SUPPLY rated at 4A continues ‹0.0003% for all frequencies less than 10KHz and all powers below clipping
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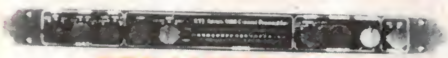

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FREQUENCY RESPONSE: High-level input: 15Hz − 130KHz, +0 −1dB
Low-Level input-conforms to RIAA equalisation + −0.2dB
DISTORTION: 1KHz ‹0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation).
S/N NOISE: High-Level input, master full, with respect to 300mV input signal at full output (1.2V)›92dB flat ›100dB A-weighted. MM input, master full, with respect to full output (1.2V) at 5 mV input 50ohms source resistance connected ›86dB flat/92dB A-weighted MC input, master full, with respect to full output (1.2V) and 200uV input signal ›71dB flat ›75dB A-weighted

Cat. K44791 .... **$399**
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SPECIFICATIONS:
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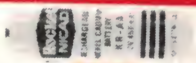

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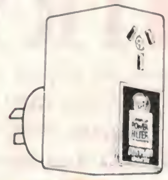
Weight: 160 grams
RECIEVER SPECIFICATIONS:
Recieving Freq: 37.1MHz
Output Level: 30mV (maximum)
Recieving System: Super heterodyne crystal oscillation
Power Supply: 9V Battery or 9V DC power adapter
Volume control
Tuning LED
Dimensions: 115 x 32 x 44mm
Weight: 220 grams

Cat. A10452 .... R.R.P. $113
Our price, $99

ULTRASONIC TRANSDUCERS

Designed to transmit at 40kHz (L19990) and receive at 40kHz (L19991) with up to 20V I/P on the transmitter. These units can't be heard and so are ideal for TV remote controls, water level detectors, burgalar alarms, motion detectors and information carriers as they can be either pulsed or used in the continuous wave mode.
Full specifications below for design purposes.
Maximum Input Voltage: 20V rms
Centre Frequency (kHz): 40 ± 1.0
Sound Pressure Level 10V RMS: 110dB min
Sensitivity (dB/v/ubar) min.: 65 min
Bandwidth (kHz):
Transmit 4.0 (at 100dB)
Receiver 5.0 (at −73dB)
Impedance:
Transmit 500
Receiver 5000

Cat. L19990 (Transmitter) **$6.95**
Cat. L19991 (Receiver) **$6.95**



CPF CONTINUOUS POWER FILTER SPIKE ARRESTOR

The Fortron CPF Filtered Electronic Spike Protector provides a protective electronic barrier for microcomputers, printers, telephone systems and modems electronic typewriters, audio and stereo systems and other sensitive electronic equipment.

The CPF provides protection from dangerous electrical spikes that can cause anything from obvious damage (like immediate equipment failure) to less obvious harm that can drastically shorten a system's life.

CPF's superior circuitry design and semi conductor technology responds instantly to any potentially damaging over-voltage, ensuring safe trouble free operation.

Additionally, CPF's filtering capability helps eliminate troublesome and annoying interference, general hash created by small motors, fluorescent lamps, and the like that threaten the performance and shorten equipment life of unprotected electronic components.

SPECIFICATIONS:
Electrical rating: 220-260 volts (AC) 50Hz 10 Amp
Spike/RFI Protection: 4,500 amps for 20m/second pulses
Maximum clamping voltage: 275V differential mode

Cat.X10088 .... **$69.95**

SPECTROL MULTIDIALS

MODEL 15-1-11

Number of turns: 10
Minor Scale Division: 1/500 turn
Shaft Bore: 6.35mm (1/4")
Finish: Satin Chrome
Body Size: 25.4 x 44.45mm (1 x 1 3/4")
Depth: 25.4mm (1")
Weight: 45.4g (1.6oz.)

Cat.R14405 .... **$45.95**
SPECIAL, $35.95

MODEL 16-1-11

Number of turns: 15
Minor Scale Division: 1/50 turn
Shaft Bore: 6.35mm (1/4")
Finish: Clear Anodize
Body Size: 22.2mm diameter (.875")
Depth: 22.2mm (.875")
Weight: 19.8g (0.7oz.)

Cat.R14400 .... **$26.95**
SPECIAL, $21.50

MODEL 21-1-11

Number of turns: 15
Minor Scale Division: 1/100 turn
Shaft Bore: 6.35mm (1/4")
Finish: Satin Chrome
Body Size: 46.04mm diameter (1.812")
Depth: 25.4mm (1")
Weight: 85 g (3oz.)

Cat.R14410 .... **$46.95**
SPECIAL, $37.50

RELAY AND BASE

Can carry 10A at 28V DC or 5A at 240V AC. Supplies with Chassis Mounting Socket with screw terminals. Great for school projects and demonstrations, switching DC power supplies, central circuits and with contacts parallel up to 20A can be switched.

Cat. S14074 .... Normally $8.95
SPECIAL $6.95

DIECAST BOXES

Diecast boxes are excellent for RF shielding and strength. Screws are provided with each box.

H11451	100 x 50 x 25mm	$5.95
H11452	110 x 60 x 30mm	$6.50
H11453	120 x 65 x 40mm	$6.95
H11461	120 x 94 x 53mm	$11.50
H11462	188 x 120 x 78mm	$13.50
H11464	188 x 188 x 64mm	$29.50

ROTATING LIGHT

Motor driven rotating reflecting mirror with a flash rate of about 150 per minute. Large lens fit right to base, making unit weatherproof. Spare globe included.

SPECIFICATIONS:
• Available in Blue or Orange
• 150 Revolutions per minute (approximately)
• Shock absorbing rubber mounting legs
• Connecting wire fitted through base
• 12V DC 750mA
• Base diameter 102mm
Height 140mm

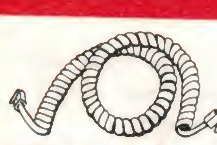
A15042 Blue **$42.95**
A15043 Orange... **$42.95**

ELECTRET MIC INSERTS

With pins for easy board insertion
Cat. C10170

1-9	10+	100+
$1.20	$1.00	$0.90

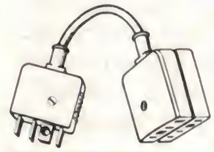
THIS MONTH ONLY!



TELEPHONE CURL CORD

• U.S. plug to U.S. plug
• Replacement hand set cord
• Length 4.5 metres

Cat. Y16023 .... **$7.95**



TELECOMMUNICATION PLUG TO 2 SOCKETS.

Ideal for modem connections
Cat. Y16014 .... **$12.95**

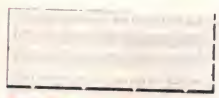
TV INTERFERENCE FILTER

Cuts CB/Ham signals interference
Cat. L11048 .... **$5.95**

UTILITY BOXES

Plastic boxes with aluminium tops, and available in four sizes. Very popular for projects and very economical!

H10101	150x90x50mm	$3.25
H10102	195x113x60mm	$4.50
H10103	130x68x41mm	$2.75
H10105	83x54x28mm	$1.95
H10110	120x65x38mm	$2.95
H10112	120x65x38mm (Metal too)	$2.95



BREADBOARDS

Cat. No.	Description	Price
P11000	100 Holes	$2.75
P11005	640 Holes	$10.75
P11007	640 + 100 Holes	$14.95
P11009	640 + 200 Holes	$17.50
P11010	1280 + 100 Holes	$26.95
P11011	1280 + 300 Holes	$32.50
P11012	1280 + 400 Holes	$39.95
P11015	1920 + 500 Holes	$59.95
P11018	2560 + 700 Holes	$69.95

10W HORN SPEAKERS

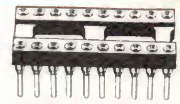
White durable plastic, 8 ohms
Cat. C12010 .... Normally $11.95
SPECIAL, ONLY $9.95

BIG MOUTH CAR ALARM

FEATURES.....
• Easy installation
• Automatic on/off
• Loud alarm signal
• Auto reset
• Low Price!

SPECIFICATIONS:
Power: DC 12V battery
Current Consumption: 10mA at 12V DC
Dimensions: 139 x 165 x 136mm
Exit Delay: 60 seconds approx
Entry Delay: 12 seconds approx
Auto reset: 90 Seconds approx

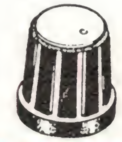
S15048 .... **$39.95**



GOLD INSERT LOW PROFILE IC SOCKETS

• Gold machined pins
• Extremely high quality
• Anti-wicking
• Ideal for professional use or where field service of components is required

Cat.No.	Description		1-9	10+
P10620	8	pin	$1.20	$1.10
P10624	14	pin	$1.60	$1.50
P10626	16	pin	$1.90	$1.80
P10628	18	pin	$2.00	$1.80
P10630	20	pin	$2.20	$2.00
P10632	22	pin	$2.40	$2.20
P10634	24	pin	$2.60	$2.40
P10640	28	pin	$2.90	$2.60
P10644	40	pin	$3.00	$2.70



NEW COLOUR KNOBS!

Standard metric fluted shaft with black dot marker and available in six different colours!

Dimensions: 17.2mm high
12.8mm top diameter
17mm bottom diameter

Cat.No.	Colour	1-9	10+
H10070	Black	$0.75	$0.65
H10071	Blue	$0.75	$0.65
H10072	Green	$0.75	$0.65
H10073	Grey	$0.75	$0.65
H10074	Red	$0.75	$0.65
H10075	Yellow	$0.75	$0.65

TDK LINE FILTERS

240 V 3A
Cat. **$12.50**

RECHARGEABLE 12V GELL BATTERIES

Leakproof and in 3 convenient sizes, these long service life batteries are ideal for burgular systems, emergency lighting or as a computer backup power supply. Ideal for many power needs.

Cat. S15029 12V 1.2 AH **$17.50**
Cat. S15031 12V 2.6 AH **$32.50**
Cat. S15033 12V 4.5 AH **$39.50**

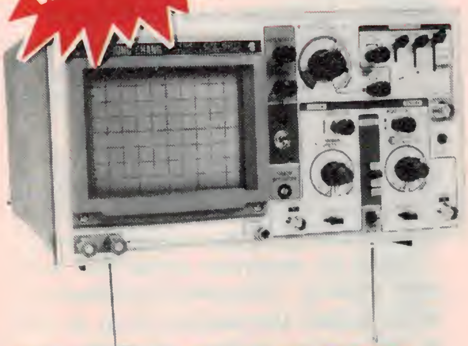
VIDEO/AUDIO TRANSMITTER

A small compact unit that allows transmission of video and audio signals (RF) to any TV set or VCR within a range of 30 metres (100') simply by tuning in on Channel 11. Can be used as a transmitter for a video camera. With power on LED, on/off switch, audio and video leads and supplied with an AC adaptor.

Transmission: VHF, channel 11 (PAL)
Video Input: 75 ohms, 1V p-p
Audio Input: 600 ohms
Output Control: Audio-video fine adjustment
Power Sources: 9V battery or power adaptor
Accessories: RCA to RCA audio lead
RCA to BNC video lead
Size: 70(W) x 85(D) x 28(H)mm
Weight: 170 grams

A16150 .... **$69.95**

12 months warranty!



HUNG CHANG (RITRON) 20 MHz DUAL TRACE OSCILLOSCOPE

- Wide bandwidth and high sensitivity
- Internal graticule rectangular bright CRT
- Built in component tester
- Front panel trace rotater
- TV video sync filter
- Z axis (Intensity modulation)
- High sensitivity X-Y mode
- Very low power consumption
- Regulated power supply circuit

COMPONENT TESTER is the special circuit with which a single component or components in circuit can be easily tested. The display shows faults of components, size of a component value, and characteristics of components. This feature is ideal to troubleshoot solid state circuits and components with no circuit power. Testing signal (AC Max 2 mA) is supplied from the COMPONENT TEST IN terminal and the result of the test is fed back to the scope through the same test lead wire at the same time.

CRT
CRT: 6" (150mm) Flat-faced high brightness CRT with Internal Graticule
Effective display area: 8 x 10 div (1 div 10 mm)
Acceleration potential: 2KV

VERTICAL
Operating Modes: CH-A, CH-B, DUAL, ADD (CH-B can be inverted.)
Dual modes Alter. 0.2ufs - 0.5ms/div Chop. 1ms - 0.5s/div
CHOP frequency 200KHz approximately
Deflection factor: 5mV/div 20V/div +/- 3%, 12 ranges in 1-2-5 step with fine control
Bandwidth: DC, DC - 20MHz (- 3dB) AC: 10Hz - 20MHz 3dB)
Rise Time: Less than 17ns
Overshoot: Less than 3%
Input Impedance: 1M ohm +/- 5%, 20pF +/- 3pF
Maximum Input Voltage: 600Vp-p or 300V (DC + AC Peak)
Channel Isolation: Better than 60 dB at 1KHz

HORIZONTAL
Sweep Modes: NORMAL, and AUTO
Time Base: 0.2ufs - 0.5s/div +/- 3% 20 ranges in 1-2-5 step with fine control
Sweep Magnifier: 5 times (5X MAG)
Linearity: 3%

TRIGGERING
Sensitivity: INTERNAL 1 div or better for 20Hz - 20MHz (Triggerable to more than 30MHz) EXTERNAL 1Vp-p or better for DC - 20MHz (Triggerable to more than 30MHz)
Source: INT, CH-A, CH-B, LINE and EXT
Slope: Positive and Negative, continuosly variable with level control PULL AUTO for free-run
Coupling: AC, HF-REJ and TV TV SYNC Vertical and Horizontal Sync Separator Circuitry allows any portion of complex TV video waveform to be synchronized and expanded for viewing TV-H (Line) and TV-V (Frame) are switched automatically by SWEEP TIME/DIV switch
TV-V 0.5s/div to 0.1ms/div TV-H 50ufs/div to 0.2ufs/div

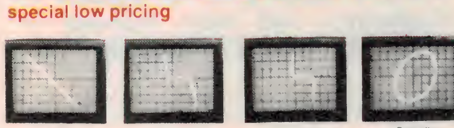
X-Y OPERATIONS
X-Y Operations: CH-A: Y axis CH-B X axis Highest Sensitivity 5mV div.

COMPONENT TESTER
Component Tester: Max AC 9V at the terminal with no load Max current 2mA when the terminal is shorted (Internal resistance is 4.7K ohm)

OTHER SPECIFICATIONS
Intensity Modulation: TTL LEVEL (3Vp-p), Positive brighter
BANDWIDTH, DC - 1MHz MAXIMUM INPUT VOLTAGE 50V (DC + AC Peak)
Calibration Voltage: 0.5Vp-p +/- 5%, 1KHz +/- 5% Square wave
Trace Rotation: Electrically adjustable on the front panel
Power Requirements: AC, 100, 120, 220, 240V 20W
Weight: 7kg approximately
Size: 162(H) x 294(W) x 352(D)mm

Cat. Q12105 .... **only $849**
(tax exempt only *$695*)

Bulk orders, schools, please phone (03) 543 2166 for special low pricing



METEX 3530 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3½ digit multimeter for measuring DC and AC voltage, DC and AC current, Resistance and Diode, Capacitance, Transistor hFE and Continuity Test. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications.

Features...
- Push-button ON OFF power switch
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection
- ½ high contrast LCD
- Automatic over-range indication with the 1 displayed
- Automatic polarity indication on DC ranges
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows 000 or 001
- High Surge Voltage protection 1.5 KV-3 KV
- Capacitance measurements to 1pF
- Diode testing with 1 mA fixed current
- Audible Continuity Test
- Transistor hFE Test

SPECIFICATIONS
Maximum Display: 1999 counts 3½ digit type with automatic polarity indication
Indication Method: LCD display
Measuring Method: Dual-slope in A-D converter system
Over-range Indication: 1 Figure only in the display
Temperature Ranges: Operating 0 C to 40 C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat Q91540 **Normally $139**
SPECIAL $109

METEX 3800 MULTIMETER

This instrument is a compact rugged battery operated hand held 3½ digit multimeter for measuring DC and AC voltage DC and AC current Resistance and Diode for testing Audible continuity and transistor hFE The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing polarity selection and over-range indication Full overload is provided It is an ideal instrument for use in the field laboratory workshop hobby and home applications

Features...
- Push-button ON OFF power switch
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection
- ½ high contrast LCD
- Automatic over-range indication with the 1 displayed
- Automatic polarity indication on DC ranges
- All ranges fully protected plus Automatic ZERO of all ranges without short circuit except 200 ohm Range which shows 000 or 001
- High Surge Voltage protection 1.5 KV-3 KV
- Diode testing with 1 mA fixed current
- Audible Continuity Test
- Transistor hFE Test

SPECIFICATIONS
Maximum Display: 1999 counts 3½ digit type with automatic polarity indication
Indication Method: LCD display
Measuring Method: Dual-slope in A-D converter system
Over-range Indication: 1 Figure only in the display
Temperature Ranges: Operating 0 C to 40 C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat Q91530 **Normally $109**
SPECIAL $79

METEX M-3650 MULTIMETER

20A, 3½ digit frequency counter multimeter with capacitance meter and transistor tester.

This spectacular rugged and compact DMM has a bright yellow high impact plastic case It features a frequency counter (to 200kHz), diode and transistor test, continuity (with buzzer), capacitance meter, up to 20 amp current measurement and comprehensive AC/DC voltage current and resistance ranges

CHECK THESE FEATURES....
- Push-button ON/OFF switch
- Audible continuity test
- Single function, 30 position easy to use rotary switch for FUNCTION and RANGE selection
- Transistor test
- Diode test
- Quality probes
- ½" High contrast LCD
- Full overload protection
- 20 Amp
- Built in tilting bail
- Capacitance meter
- Instruction manual

Q91550 .... Normally $165
Special, only $149

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
LOCAL: 543 7877

ADCOLA E024 SOLDER SYSTEM

The E024 is a top quality Australian made soldering station suitable for use with either the Adcola CT-6, CT-7 irons or desoldering pencil The E024 features a continuosly adjustable temperature range from 200°C to 400°C The E024 s electronic temperature control circuit monitors the temperature element in each of the irons, allowing it to maintain a constant temperature to within an incredible +/- 5°C of the temperature dial setting on the front panel

Power to the irons is via a zero crossing controller The power to the irons is switched on off at a point on the AC power supply where the voltage passes through zero Hazardous spikes caused by commutated AC are avoided using this technique

Mains spikes are virtually eliminated by an electrostatic shield wound between the primary and secondry of the power transformer an important safegaurd for easily damaged MOS devices To further safegaurd sensitive components an auxiliary ground lead earths the equipment to be soldered to the same level as the solder station limiting the effective tip EMF to approximately 10mV (Well below the damage level for MOS devices) If static control is important the E024 unit is an excellent choice

E024 Base Station & CT7 Iron
Cat T12570 **$195**

METEX 4500H MULTIMETER

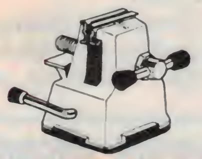
10A, 4½ digit multimeter with digital hold, transistor tester and audible continuity tester.

The Metex 4500H is perfect for the technician engineer or enthusiast who requires the higher accuracy of a 4½ digit multimeter This meter is exceptionally accurate, (just look at the specifications), and yet, still retains an exceptionally low price!

The Metex 4500H features digital hold which is normally only found on very expensive multimeters This enables you take a reading and hold that reading on display even after you have removed the probes, simply by pressing the hold button

CHECK THESE FEATURES...
- Readout hold
- Transistor Tester
- 4½ digit x ½" (H) LCD
- Audible continuity tester
- Push-button ON/OFF switch
- Quality set of probes
- Single function 30 position easy to use rotary switch for FUNCTION and RANGE selection
- Built in tilting bail
- Instruction manual
- Full overload protection
- hFE test
- Battery and Spare fuse
- Diode Tester
- Vinyl case

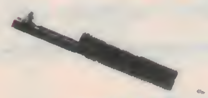
Q91560 .... Normally $175
Special, only $159



MINIATURE HOBBY VICE

- Lever operated suction grip base for instant mounting and portability
- Mounts on smooth non-porous surfaces
- Ideal for holding components and other small light objects

Cat.T12458 .... **only $5.45**



REGULAR SOLDER SUCKER

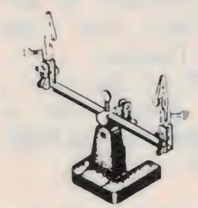
- Light weight
- Sturdy construction
- Easy to remove tip
- Excellent value for money!

Cat T11271 **$11.95**

ANTISTATIC SOLDER SUCKER

- Light weight
- Sturdy construction
- Easy to remove tip
- Excellent value for money!

Cat T11281 **$13.95**



PC BOARD HOLDER

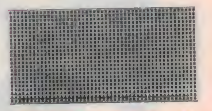
Better than an extra pair of hands! A must for all PCB work
Cat T12444 **$9.95**

WELLER WTCPN SOLDERING STATION

The WTCPN Features
- Power Unit 240 V AC
- Temperature controlled iron, 24 V AC
- Flexible silicon lead for ease of use
- Can be left on without fear of damaged tips!

The best is always worth having

Cat T12500 **R.R.P. $149**
SPECIAL, ONLY $129



VEROBOARD SPECIALS

VERO 21070H
0.1" pitch strip board
Size 2.5 x 3.75 inches
H21070 Normally $7.50
SPECIAL, $4.95

VERO 21000F
0.1" pitch strip board
Size 3.75 x 17.9 inches
H21000 Normally $25.00
SPECIAL, $17.95

VERO 21012H
DIP Bread board The design of this board is similar to that of the plug-in range of DIP Boards, except that it is not provided with gold plated contacts They therefore offer a cost saving in those experimental applications where a plug in facility is not required In place of contacts, individual mounting pads for terminal pins are provided
Matrix 2.54 x 2.54mm
Hole Diameter 1.02mm approx
H21012 Normally $27.95
SPECIAL, $17.95

rie

Rod Irving Electronics

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Phone (03) 663 6151

NORTHCOTE 425 High St
Phone (03) 489 8866

CLAYTON 56 Renver Rd
Phone (03) 543 7877

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Electronic Discounters P/L
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(03) 543 7877

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$10	$24.99	$3.00
$25	$49.99	$4.00
$50	$99.99	$5.00
$100	$199	$7.50
$200	$499	$10.00
$500 plus		$12.50

The above postage rates are for basic postage only Road Freight bulky and fragile items will be charged at different rates

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56 Renver Rd, Clayton
Ph (03) 543 2166 (3 lines)

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News Highlights

Comparison of PET images of a human brain taken with an older 280-crystal scanner (left) and the new LBL 600-crystal scanner (right). Note the improved resolution.

New PET scanner has twice the resolution

A new positron emission tomograph (PET) system twice as precise as any other in the world has begun operation in the Biology and Medicine Division of the Lawrence Berkeley Laboratory, at the University of California.

The new PET system can image the human head and other organs with a spatial resolution of 2.5mm.

According to Dr. Thomas F. Budinger, who heads LBL's Research Medicine Group, 'the higher resolution of the new scanner permits the imaging of structures in the cortex of the brain that were not previously observable. This can be important for studies of disorders such as Alzheimer's disease.'

The new instrument, built by physicists Stephen Derenzo and Ronald Huesman of LBL, is known as the Donner 600-Crystal Positron Tomograph. It uses 600 crystal detectors, rather than the 280 used in previous PET scanners.

These instruments are used in the study of biological function and in the diagnosis and treatment of disease, including cancer, stroke, brain tumors, Alzheimer's disease, radiation damage, arteriovenous malformations, schizophrenia, depression and heart disease.

PET is one of several biological imaging techniques that have in recent years revolutionised the art of medical diagnosis.

'PET is unique among the new imaging techniques in one very important respect,' says Budinger, 'It measures body chemistry rather than simply anatomy.'

This is an important distinction, Budinger explains. Anatomical techniques – which include the familiar X-ray as well as the newer nuclear magnetic resonance (NMR) imaging, ultrasound and computerised tomography (CT) – are simply ways to look inside the body without cutting it open. The physician or researcher sees what he would see if he dissected an organ and looked at it.

PET, on the other hand, provides more information than could be achieved by dissection or actual observation. Because it measures tracer concentrations up to a million times better than other techniques, it allows the study of microscopic, virtually invisible processes – like the passage of nutrients through a membrane – as they take place.

'Because of this capability, PET is known as a 'functional' technique – one of the few available to use,' says Budinger.

Society for sound recording historians

The Phonograph Society of NSW caters for those with an interest in sound recordings and equipment, especially the historic aspects of these - including cylinders, discs, magnetic tape, sound films and digital carriers, and the artists and engineers who made them.

The Society meets on the second Friday of each month, usually at the Veteran Car Club Hall, 134 Queens Road, Five Dock. The current annual membership fee is $10. New members are always welcome.

Further details are available from the secretary, John Hanna, at 18 Macklin Street Pendle Hill 2145.

Philips Megachip: status report

Following on from our story in the April issue on this project, Philips has advised that the new submicron MOS production facility in Nijmegen (the 'Cathedral') has now commenced three-shift operation. It produced its first product using 6″ wafers and 1.5um CMOS process in late February.

In the second half of this year a double-metal 1.2um process will be transferred to Nijmegen from the R&D pilot line in Eindhoven.

Philips to supply semi technology to Soviets, products to China

The Electronic Components group of Philips Netherlands has won a contract – worth more than $A19 million to deliver semiconductor manufacturing equipment and production know-how to the Soviet Union.

The contract, signed with the Soviet Ministry of Electronic Industry, represents Philips' first project in the Soviet Union as well as the first technology-transfer contract with the Russians.

Nearer home, a delegation from the People's Republic of China has placed an order for kits and receivers – worth about $A36 million – with Philips in Singapore.

The 10-man delegation was led by representatives of China's National light Industry Product Import and Export Corporation, which falls under the Ministry of Foreign Economic Relations and Trade. Commercial representatives on the delegation came from the Overseas Chinese Friendship Corporation, which is attached to the Ministry of Commerce, and their branches in Hebei, Fujian and Guangdong Province.

IBM scientists find superconductivity at 125K

Scientists at the IBM Almaden Research Centre in San Jose, California have found superconductivity, the loss of all electrical resistance, at a temperature of 125K, or −148°C. The IBM researchers believe this is the highest superconducting transition temperature ever achieved, with a material containing the elements thallium, barium, calcium, copper and oxygen. Previously, scientists at the University of Arkansas discovered superconductivity at 106K (−167°C) in a different material containing the same elements.

IBM claims the work is particularly significant because the scientists demonstrated reproducibility and stability in their zero-electrical-resistance results at 125K. The ability to reproduce scientific results is a key test for discoveries. They also established that true bulk superconductivity is occurring at this temperature by showing that the material excludes magnetic fields. This property, called the Meissner effect, is considered to be a crucial test for superconductivity.

Prior to the current excitement about the thallium-containing material, a bismuth -barium -calcium -copper -oxide material had shown hints of superconductivity at slightly lower temperatures, but zero resistance was never seen in that temperature range.

Thallium is poisonous and requires special techniques and equipment for handling and fabrication. So the potential of the material for practical application might be limited.

Printronics announces plans to expand

Local PCB maker Printronics plans to move later this year, to much larger and newly equipped premises at Rydalmere. The expansion is part of the company's plan to address the computing market at the higher end of telecommunications, including overseas offset and to participate more actively in export opportunities.

The move is planned to consolidate Printronics' position as by far the largest printed circuit board manufacturer in Australia, with the technology to produce boards to the highest international standards including Milspec 5511OP and IPC Class 5.

'We intend spending a considerable amount on new equipment for double-sided and multilayer boards, including extending the Multiline tooling system throughout the plant with a common tooling base,' said Michael Brinsden, managing director of Printronics.

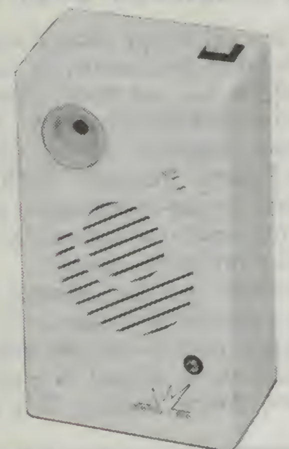
'We believe there is still enormous potential for electronics manufacturers in Australia, particularly in the high tech end of the export market, and we have never made any secret of the fact that we want to hold the lion's share of high tech PCB manufacturing in this country.'

Late last year, Printronics' Victorian factory was closed and manager Steve Lumsden moved to Sydney to become production manager.

Brian Clegg now manages the Victorian sales office at a new address in Bayswater.

News Briefs

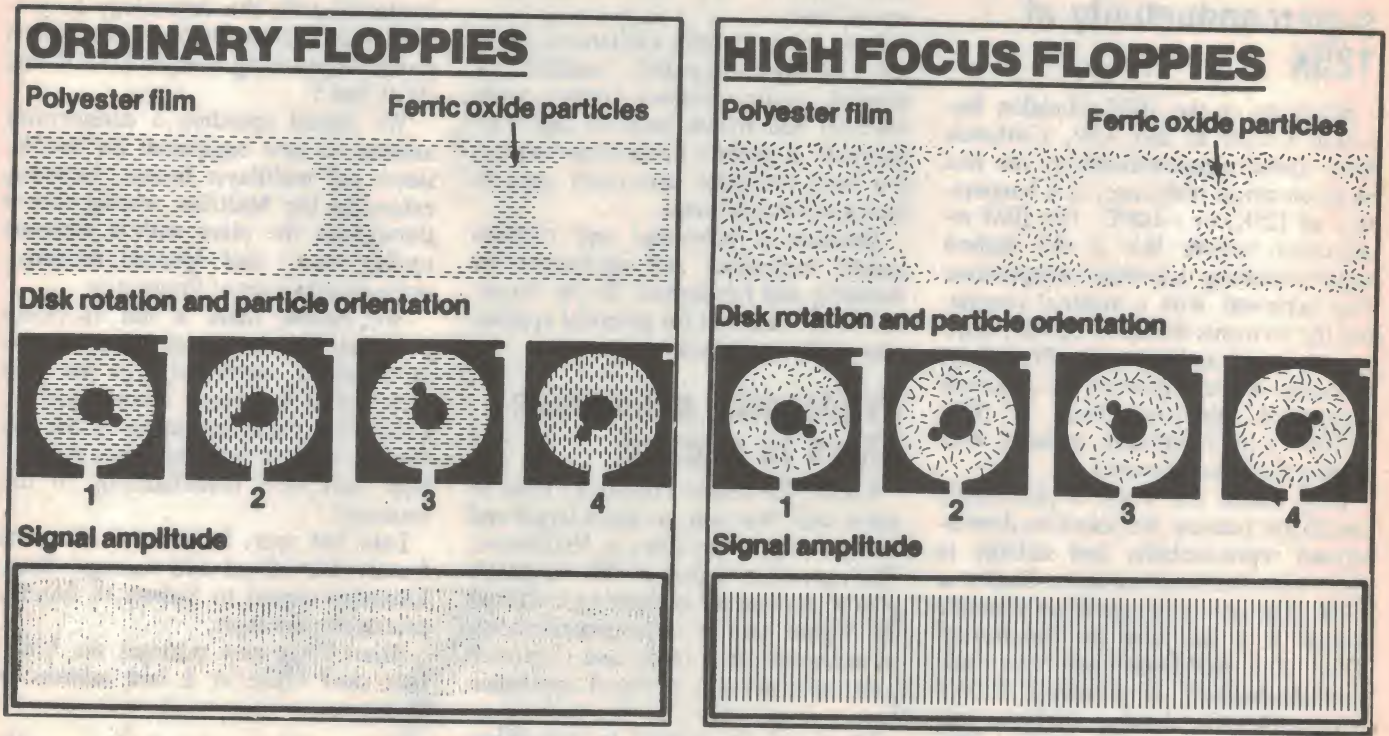
- After almost a century of operation as ***Standard Telephones and Cables Pty Ltd***, Australia's largest telecommunications company has changed its name to ***Alcatel-STC***, in line with other companies in the international Alcatel-ITT group.
- A 50/50 joint venture called Airvision has been formed between ***Philips*** of the Netherlands and ***Warner Bros*** of the USA, to market and install LCD-screen video entertainment/information systems for airlines and other transport carriers. Philips will provide the hardware, and Warner Bros. the software. The first applications will be for seat-back screens in passenger aircraft.
- The first official Australian use of ACS "piggyback" broadcasting on commercial FM transmissions has begun in Sydney, with ***Stockwatch*** - a financial information service using an ACS channel leased from 2MBS-FM. Subscribers are said to need a special sealed, pre-tuned FM receiver designed by Processor Product Development, an R&D offshoot of ***Voicecall***.
- Gympie Amateur Radio Club in Gympie, Queensland is planning an amateur get-together called ***Goldfest 88***, on Saturday 8th October. Venue is to be the Chatsworth Hall and adjoining school, beside the Bruce Highway 10 minutes north of Gympie.
- Len Heyward has been appointed managing director of ***Associated Calibration Labs*** in Melbourne, replacing Peter Williams. Mr Williams is to remain a consultant, but will spend several years ocean cruising.
- Melbourne-based ***Vicom International*** has acquired the assets of the Scalar Group of companies. A new company called ***Vicom Scalar Pty Ltd*** has been formed to take over Scalar's manufacturing, exporting and marketing activities.
- Australian fibre-optic data comms equipment maker ***Integral Fibre Systems*** has been acquired by ***Andrew Sweeney Electronics***.
- Winner of the Federal Publishing Christmas Catalogue Promotion was B.D. Maclean of 4 Peel Place, Sylvania Waters 2224, now the proud owner of the Achilles inflatable Fun Boat and its accessories.
- ***Electron House Holdings (Australia)***, a member of the Electron House PLC Group of Companies has acquired the business and assets of ***Promark Electronics*** and ***Promark Electronics (Vic).*** Ted Mooney, Chief Executive of Electron House Australia will act as managing director of Promark Electronics and Les Torok (Group Finance Director of E.H.H Australia) will be Finance Director.



Solid state message recorder

A novel device which records any desired spoken message in a VLSI memory chip and plays it back automatically when a person approaches has been released in Australia by Melbourne firm Arthrite Australia.

Called the 'Memo-Me', the unit comes in two versions. One records messages of either 8 or 16 seconds duration (ME-10), the other twice these figures (ME-20). Both units are very compact and operate from an external 9V DC power supply. The inbuilt ultrasonic sensor is said to detect movement within 4-5m, for automatic playback. RRP is around $100.



New diskettes offer freedom from 'modulation'

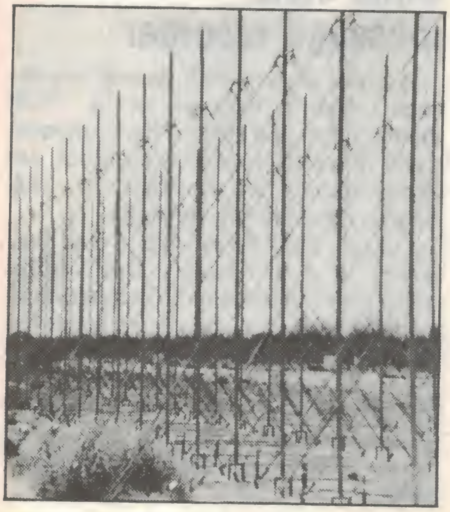
A range of floppy disks claimed to offer freedom from amplitude modulation effects has just been released in Australia. Manufactured by leading European magnetic media producer Rhone-Poulenc Systemes (RPS), the new disks feature an 'enhanced isotropic' coating said to overcome the effects of particle orientation 'grain'.

RPS claims that the influence of the earth's magnetic field causes the magnetic oxide particles on the surface of most discs to be aligned in a common direction, during coating. This inbuilt 'grain' in turn causes a regular variation in remanence during rotation of the disk, and consequent modulation of replay signal amplitude – even for saturation-type digital recording.

To overcome this effect, RPS manufactures its High Focus diskettes in a controlled environment, which negates the effects of the earth's field and produces a truly random or isotropic orientation of the particles. It claims this gives an improved ANSI clipping level safety margin of 75%, compared with the 35-40% achieved by most other diskettes.

The oxide layer of the new diskettes also includes an integral lubricant, said to extend the life of the diskette by a factor of 10 times compared with conventional disks with only a surface coating of lubricant.

Both features are said to make the new disks much more reliable, and more suitable for business use where security of recorded data is paramount. Further details are available from WPA Supply Company, 3 Albany Street, St Leonards 2065 or phone (02) 438 1822.



Australian antennas for Jindalee

The prototype of the high-performance Australian antennas for the Jindalee over-the-horizon radar (OTHR) network is to be tested at Kilsyth, Victoria, this month. It should be fully operational at the Jindalee transmission site near Alice Springs later this year.

Melbourne-based radio frequency systems Australia, as subcontractor to AWA, is designing, installing and commissioning the antenna and masts for the Department of Defence.

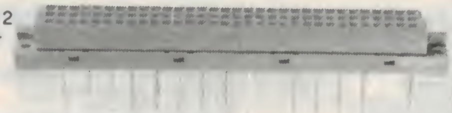
Among the most challenging aspects of the project was designing the installation to withstand cyclonic conditions. The company's engineering services manager, Mr Barry Styles, said: 'We put about 80% of our effort into producing a design that meets Australian wind-loading standards – among the toughest in the world'.

The marketing manager for RFS Australia, Norwegian-born Mr Odd-Erik Jenssen, said the company had recently achieved very stringent specifications which had been set for the 25kW balun transformers that would be used in conjunction with the antennas.

OTHR systems give far greater coverage and penetrate much longer distances than conventional radar by beaming the signal skywards and bouncing it off the ionosphere and back to earth.

WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR C

SYDNEY'S MOST COMPREHENSIVE RANGE OF DIN41612 CONNECTORS?



Geoff is now stocking most of the DIN41612 range of plugs and sockets. The coding for the uninitiated is as follows -
There are three rows of pin locations A,B and C. E indicates even pins only.
The body size and number of pins is quoted each time thus 96/32 is a 96 hole body fitted with 32 pins
STR = straight connection R/A = Right angled
PCB = circuit board mounting WW = Wire Wrap

PLUGS

BODY/PINS		CONNECTION		PRICE
P64/32	A	STR	PCB	$8.00
P64/64	A+B	STR	PCB	$12.55
P96/32	A	STR	PCB	$8.65
P96/32	A+CE	STR	PCB	$8.65
P96/64	A+C	STR	PCB	$13.55
P96/96	ALL	STR	PCB	$11.45
P64/32	A	R/A	PCB	$5.90
P64/64	A+B	R/A	PCB	$8.40
P96/96	ALL	R/A	PCB	$12.55
P96/32	A	R/A	PCB	$5.85
P96/64	A+C	R/A	PCB	$8.40
P96/32	A	R/A	PCB	$6.40
P96/32	A+CE	R/A	PCB	$6.40
P96/64	A+C	R/A	PCB	$8.40
P64/32	A	STR	WW	$8.65
P64/64	A+B	STR	WW	$13.65
P96/32	A	STR	WW	$10.65
P96/32	A+CE	STR	WW	$10.65
P96/64	A+C	STR	WW	$11.45
P96/96	ALL	STR	WW	$13.55

SOCKETS

BODY/PINS		CONNECTION		PRICE
S64/32	A	STR	PCB	$8.00
S64/64	A+B	STR	PCB	$13.65
S96/96	ALL	STR	PCB	$16.35
S96/32	A	STR	PCB	$8.00
S96/64	A+C	STR	PCB	$12.55
S96/32	A+CE	STR	PCB	$8.00
S64/32	A	R/A	PCB	$8.00
S96/96	ALL	R/A	PCB	$18.40
S96/64	A+C	R/A	PCB	$13.55
S96/32	A+CE	R/A	PCB	$8.65
S96/32	A	R/A	PCB	$8.65
S64/32	A	STR	PCB	$8.00
S96/32	A	STR	PCB	$8.65
S96/32	A+CE	STR	PCB	$8.00
S64/64	ALL	STR	PCB	$13.55
S96/64	A+C	STR	PCB	$11.45
S32/32	A	STR	WW	$8.65
S64/32	A	STR	WW	$8.65
S96/32	A	STR	WW	$8.65
S96/32	A+CE	STR	WW	$8.65
S96/64	A+C	STR	WW	$11.45
S96/96	ALL	STR	WW	$18.35
S96/96	ALL	STR	WW	$18.35
S96/32	A	STR	WW	$8.65
S96/64	A+C	STR	WW	$13.65
S96/32	A+CE	STR	WW	$8.65

LED DISPLAY SPECIALS

FND500 REPLACEMENT

So many projects have used the popular FND500 led display. Alas the FND500 is no longer available. But Geoff has found a direct replacement - the LTS543 from Liton. And they're only 80cents each if you buy ten of 'em. But hurry!
LTS543 $8.00/ten
$1.20 each.

0.8" GREEN DISPLAYS

7 segment common cathode with R&L hand decimal points.
Peak wavelength is 565µm
If is 10mA (25mA max)
Only a few available
LTS3403 $4.50

1.02" GREEN DISPLAYS

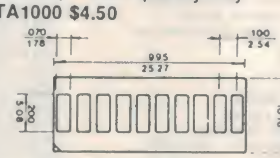
7 segment common cathode with R hand decimal point.
Peak wavelength is 565µm
If is 10mA (25mA max)
Only a few available
LTS1723 $5.50

1.02" RED DOT-MATRIX DISPLAYS

Anode column by cathode row dot matrix display with 35 leds.
Peak wavelength is 655µm
If is 10mA (25mA max)
Only a few available
LTP1057 $7.50

10 POINT BAR GRAPH DISPLAYS

Red, light red, green and yellow
Extremely limited quantity only
LTA1000 $4.50

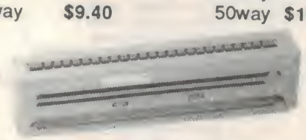


Don't just ask Geoff for DIN41612...

You'll find one of the widest ranges of leading brands of connectors - ex stock - at Geoff Wood's.
So call in and discuss your requirements!

0.1" PITCH IDC CARD EDGE CONNECTORS

26 way	$8.50	40way	$11.55
34 way	$9.40	50way	$13.95



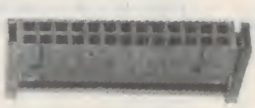
HEADER PLUGS

10way	R/A	$6.90
14way	R/A	$7.65
	STR	$5.90
16way	R/A	$4.20
	STR	$4.20
20way	R/A	$7.65
26way	R/A	$4.90
34way	R/A	$6.20
	STR	$5.40
40way	R/A	$8.55
	STR	$9.80
50way	R/A	$10.60
60way	R/A	$11.70

IDC "D" CONNECTORS

9pin	Plug	$6.40
	Socket	$6.40
15pin	Plug	$7.60
	Socket	$7.60
25pin	Plug	$8.40
	Socket	$8.90
37 pin	Plug	$20.40

TRANSITION SOCKETS



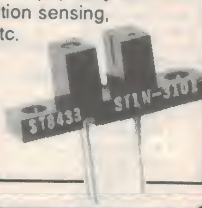
10way	$3.55
14way	$4.75
16way	$4.70
26way	$5.20
34way	$5.70
40way	$7.80
50 way	$7.40
64way	$14.85

5mm SQUARE LEDS

Parallel sides for easy stackability. Choice of three colours - red, light red and green - all at the same low price of **30c** each ($2.70 for ten all the same colour)
And if you're after 3mm **Yellow leds** they're just **20c** each!

PHOTO INTERRUPTER

A real handy gadget for anyone into robotics. Consists of a LED(Max If 60mA) and 30V phototransistor facing each other across a 3mmx7mm gap. Any object in the gap stops the light and switches the transistor off. Very fast (5µs).Easy to mount. Use in counting, position sensing, tacho, opto ignition etc.
You could pay more than twice Geoff's price of
$4.00 each.



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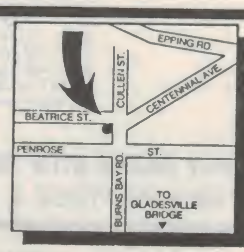


SUPPORT WORLD WILDLIFE FUND AUSTRALIA

A Preface to our new Oral History series

When we first saw Jim Lawler's series of articles on recording oral history, we were struck by two things. One was how timely the series was, in this year of Australia's Bicentenary. The other was how appropriate such a series was for a magazine like *Electronics Australia*, since so many of our readers are familiar with tape recorders and their operation.

To give added impact to this month's launch of the series, we asked our former Editor-in-Chief and regular contributor Neville Williams (himself the worthy subject of some forthcoming ABC oral history programs) to write a preface, and he was happy to oblige. Here's what he wrote:

History is where you find it!

My wife was born in the Shetland Islands, a small group off the northern tip of Scotland containing, amongst other things, the most northerly kirk in the UK.

After more then 50 years of contact with Shetland families, two visits to the islands and countless letters, postcards and newspaper clippings, I am reasonably familiar with their local culture.

The Shetlands are rich in history. They still celebrate their viking roots with the annual *Up-helly-A'* – the building and burning of a viking funeral ship. There are standing stones reminiscent of Stonehenge, brochs once occupied by the 'little people', the Picts, castles that belonged to the feudal Lairds, stone dykes and humble croft houses, evidence of the once huge herring industry, reminders of two world wars and so on.

Shetland may not be unique in this respect, but much of all their history has been preserved by archeological research and writings, by newspaper articles and by word of mouth – despite the enormous social disruption brought about by the North Sea oil industry.

I mention this because it contrasts so strongly with the cavalier attitude of Australians to their own social history. For sure, historians, of late, have sought to present a more balanced picture of Australia as a continent and a nation but, as suggested by Jim Lawler in the following first article of his series, 'textbook' history needs to be 'fleshed out' by intimate glimpses of real people who lived in particular times and places.

In Shetland, the herring sheds are still there but the last generation of those who actually worked in the sheds and the fleet has all but gone. I myself once had the opportunity to record their stories in the original hard, Shetland brogue, but it didn't occur to me to do so until it was too late!

I wonder whether you've ever noticed the number of disused shops, houses and farm buildings that sprinkle the Australian countryside. People must have built them and planned their lives around them. But who, when, why – and what went wrong? In another few years, what remains of the buildings will be scavenged and/or will disappear into the undergrowth; nearby residents who may remember the circumstances will have passed on.

When that happens, whole generations of people, buildings and information will have been lost, apart perhaps from few faded photographs and vague impressions.

What better time than this, Australia's Bicentenary year, for imaginative enthusiasts, school teachers and school children to plan their own private research project, and to head out there with a tape recorder and a guide list of questions about:

- The little corner shop in your suburb, that was once a rendezvous for mothers and kids;
- The silent sawmill in your country town, that once produced most of the timber for local homes;
- The deserted railway station that was once the focal point for local comings and goings; and so on.

The tape you make may provide material for an essay, or be worth including in the school library. It may earn a place in the local library or museum.

Who knows? You may even unearth a story or a character which gives your recording the appeal to make it 'to air' and to end up in the national archives!

It's quite a challenge, and Jim Lawler's series of articles will help you meet it.

Neville Williams

An ideal bicentennial hobby project:

Why not try recording Australia's oral history?

This year is a very opportune time to remind ourselves that a lot of Australia's recent history is still 'locked away' in the memories of the people who lived it and made it. For anyone with an interest in our heritage, making recordings of the reminiscences of our senior citizens can be very worthwhile. You don't need a lot of fancy or expensive equipment.

This article is the first in a short series explaining what oral history recording involves, and how to go about it.

by JIM LAWLER

The history of mankind has always been taken down by scholarly scribes using clay tablets, quill pens, or typewriters. It is only in the last twenty or so years that the portable tape recorder has enabled ordinary people to become the recorders of history.

A nation's story is generally recorded by historians using a very broad brush. But the fine detail of history lies in the diaries and letters of ordinary people — or at least it did. These days few people keep diaries, and most of us tend to phone rather than write letters. So our recent history is being lost, unless an enthusiast with a tape recorder is prepared to listen to the tales told by our old folk.

Retired engineers, doctors and other professionals began their practices when this century was very young. There are 90 year old former nurses or school teachers who still have vivid memories of their early working lives. Farmers and builders and engine drivers have all lived through momentous times, and they are the only people who really know what it was like in 'The Old Days'.

Just think what an 87 year old ex-cook could tell you about food preparation and storage, in the days before refrigeration. Or the former airline pilot who learned to fly with the legendary Smithy.

The wartime experiences of service men and women, and civilians, has been thoroughly documented. It's the lives of those same people before and after the wars that is the undocumented history, which should be recorded before it is lost forever.

The nice thing about history recorded

The author interviewing the driver of a diesel-hydraulic rail motor at the Tasmanian Transport Museum in Hobart. The lightweight portable recorder is a 20 year old Sony TC100, still working well and ideal for this kind of work.

on tape is that it is taken down in the very words of the people who lived the history. Written history uses the words of the scholars to describe the activities of ordinary people, and these words often miss the point. Oral history records the people's own words, in their own voices, and doesn't leave much room for mis-interpretation.

Anybody over ten years old has a history that is worth recording. It might not be of much interest until the person is 80 years old, but think of the value of that ten-year-old's words and thoughts when his history is being evaluated 70 years from now!

In the meantime, we should try to gather as much material from today's 70, 80 or 90 year olds as we can. They won't be here forever, and then it will be too late.

Background

In 1986, the Australian Bicentennial Authority put up the money for the Australian Broadcasting Corporation to train a number of older Australians in the arts and techniques of radio production. The Authority wanted to sponsor a series of 26 one hour programmes about the Bicentennary, produced by the people who had lived through a large part of the history to be recorded.

The scheme proceeded under the awkward name 'OARTS', or Older Australians Radio Training Scheme, and groups of ten to twelve 'over 55 year olds' were selected to undertake the training in each state.

The scheme began with a ten week course in Hobart, then in each capital city in turn until now there are about 80 enthusiastic oldies around Australia. Graduates are keen to get on with the projects, which will see their productions broadcast over ABC's Radio National during this Bicentennial year.

I was one of the Hobart group, and I gained a tremendous store of knowledge about radio production and techniques. But one thing that worried me was that when the course finished, we would no longer have access to the ABC's professional Revox, Nagra, Studer and Sony recorders that we had used during our training.

I have had a lifelong interest in sound recording, and I have some very good quality domestic recording equipment. So I elected to do some of the training exercises on my own machines, and to test the results against the professionals. The results did not surprise me.

Only the ABC staff, listening to my efforts on studio monitors, could tell the difference between my home productions and those done in the ABC's studios. None of my fellow trainees could. My domestic equipment produced material which sounded, on air, neither better nor worse than the hundreds of interviews that are broadcast daily. My equipment would only be found wanting in the hifi world of FM broadcasting. Even so, the deficiencies would be acceptable in an interview situation.

At this point I decided that if I could produce near professional results on amateur equipment, so could the other trainees. To this end I set about writing a series of articles, to show them how to use their own equipment in the production of serious radio material.

These articles have now been rewritten into this series, for *Electronics Australia* readers. I hope to be able to show you the way into an interesting and rewarding hobby — the recording of Australia's Oral History.

Professional studio gear makes it a lot easier! The author at work in the ABC's studio 716 control room in Hobart, during his OARTS training. In the background is a Studer recorder.

Practicalities

The OARTS training with the ABC concentrated on production skills, in the reasonable belief that the basic material would be recorded on professional equipment. This is the way we trained, and the way we OARTS graduates will work towards the ABA programmes in '88.

However, there will be times when material will be available at short notice, with no access to the professional recorders or microphones. Then it will be a case of use what is available, and make the best of it.

Where to send your oral history 'gems'

Every so often, even amateur oral historians will come up with a real 'gem' – a recording of someone with a story of exceptional drama and significance, that really deserves to be heard by a wider group of people. But where do you send it, so it'll have a chance of being more widely heard?

One possibility is the Social History Unit of the ABC, Executive Producer of the Unit is Ms Jenny Palmer, who told EA that she is happy to consider recordings submitted for possible use in the Unit's national radio programs. She stressed, however, that the recordings should be of a high quality, in order to be even suitable for broadcasting.

A good idea is to write to Ms Palmer first, before sending your recording, to see if your subject material is of interest. Then ideally send a copy of your recording, not the master itself. If you do have to send the master recording, this should be clearly marked 'Master', so it will be handled with special care.

The address of the ABC's Social History Unit is 134 William Street, Kings Cross 2011. Send your letters or recordings marked for the attention of Ms Jenny Palmer, Executive Producer.

Oral history

The idea behind this series of articles will be to show YOU how to 'make the best of it' with any good quality domestic equipment. The secret is in knowing the limitations of the equipment, and not trying to exceed them.

After that, it's just a matter of practice, practice, practice. Unlike professional equipment, most domestic gear is made to look grand, not to operate easily. So you have to practice long and hard to ensure that you press the right button at the right time. (It's most embarrassing to find that you pressed the wrong button and fast forwarded the tape while your talent was delivering a most interesting talk!)

The photographs of items of equipment that will accompany these articles are presented as suggestions only. They are in no way recommendations for any particular make or model. The equipment shown should be taken as 'representative' and anything of a similar quality should be quite satisfactory.

Presentation

The collection and presentation of your material is important. There are two ways to go about gathering material. One is the *interview*, where the interviewee answers questions about the subject put by the interviewer. The other way is simply to allow the speaker to talk on about the subject, in any way they choose.

Two of the Studer recorders used by the ABC in Hobart. These machines were equipped for stereo working, ready for the change to stereo when ABC Radio moved to its new Hobart headquarters.

The *interview* enables you to get down the most important details of a story in just a few minutes. Carefully chosen questions can ensure that the main points to the story are covered in proper order. It also helps you to control the length of the story. The interview is also the way to go if the speaker is not comfortable in front of a microphone. The breaks for questions allow the speaker to collect his thoughts, and also make useful breaks in the story for editing out unnecessary details.

The *talk* is the best way to handle a good speaker who can deliver his story in a clear and entertaining manner. However, the talk has its problems. You may have the most interesting tale from an old fisherman, but a 30 minute monologue from the ancient mariner would probably bore the listener to tears.

The answer is to break the talk up into logical segements, interspersed with sound effects or comments from the interviewer/presenter. Even the longest talk has natural breaks where these effects or comments can be inserted.

Another problem is 'ums' and 'ers' and 'Y' knows'. These often pass unnoticed in day-to-day speech, but on tape they can become most annoying. However, if you edit them all out, the speech becomes stilted and unnatural. I've found that removing about two out of every three was close to optimum; leave in those that sound right.

Finally, should you present all the material, or should some be omitted?

Steam-Driven Radio: the OARTS programs

The immediate result of the ABA/ABC oral history training scheme for older Australians (as mentioned in Jim Lawler's article) is "The Great Old Spit-and-Polish Steam-Driven Radio Show", a series of 26 hour-long weekly magazine programs currently being broadcast on ABC Regional Radio at 10.10pm on Saturdays, and on Radio National at 3.03pm on Mondays.

Hosted by veteran ABC broadcaster Ida Elizabeth Jenkins ("Elizabeth" in the original *Argonauts*, and later presenter of the *Women's Session*), the programs should be of great interest to older Australians, and also to anyone interested in oral history.

Tips for oral historians

Readers of Jim Lawler's Oral History series who are interested in obtaining further information on the subject may like to contact the ABC's Social History Unit, which can supply a set of notes on the subject.

Written by the Unit's well-known broadcaster Tim Bowden, the notes cover both requirements for those wishing to submit material to the Unit, and general advice and practical tips for anyone wanting to make oral history recordings.

The notes can be obtained by applying to the Social History Unit, ABC, GPO Box 9994, Sydney NSW 2001.

This is where editing skill comes into play. It is essential to retain the hard core of the material. But so much of ordinary speech is just padding. You should be ruthless in your assessment of material to be kept — save the gutsy bits and scrap everything that is not an important part of the story.

Until you build up an editing skill, it is a good idea to discuss the exercise with a friend whose opinion you value. Most people can recognise a well edited story, without knowing just why it is well edited. Your friends will see points that you might have overlooked and the finished result will be the better for the extra attention.

What now?

So, what are you going to do with the material you have gathered? It is pointless to go to all this trouble if nobody has access to your records. Most oral history will be of strictly local interest, so your work should be readily available locally. The school, the library or the Municipal Council would be the logical place to put your records.

First, you should assemble the material onto a good quality cassette and label it carefully. Try to avoid too much documentation on the label. It's better to record your introduction on the head of the tape. The label should only include, 'Who, What, Where and When' and the running time of the tape.

If your material is of great interest and is likely to call for multiple copies, and if you can afford it, this final version of your programme should be done on 'metal' tape. Metal tapes give better fidelity, wider dynamic range, lower noise levels, and they are awfully hard to erase accidentally. This permanence is a big advantage for important historic material but this has to be balanced against the considerably higher cost of 'metal' tape.

There might be only one piece in a hundred that is of interest to a wider audience, and these will soon be sorted out by enthusiastic users of your material. If you are lucky enough to get really interesting speakers and if you present them well, you may be able to sell some of your output to local, state or national radio.

By all means try to sell your material, but don't be disheartened by failures. The important thing is to record our Oral History before it is lost forever. It's only after years of filtering that the gems of history emerge from the dross of contemporary records. But if the dross is not collected into some kind of archive, there is no chance of ever finding a gem!

Next month I will talk about recorders of different kinds and how to select one that suits the kind of 'intimate interview' that constitutes oral history.

JAYCAR NO.1 FOR BARGAINS

UHF TV TUNER

$29.95

Sanyo Model T1087RA

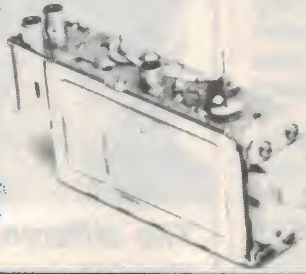
Yet another fabulous scoop purchase.

A compact high quality tuner that operates from 526-814MHz (corresponding to channels 28 thru 63). This tuner is designed for Australian standard reception (AS1053 1973), and is offered at a very low price. You can grab one now for the silly price of $29.95! This price includes circuit diagrams and connection drawing. You can have a photocopy of the complete manual for $4 but a lot of the info is in Japanese! This is a very cheap way to convert a VHF only TV to UHF! (Some skill may be required).

Specs:

Power +12V DC nominal @ 14mA. Case neg. Bandwidth 526-814MHz (28-63 ch). AFT +6.5V. Dimensions 150 x 65 x 28mm. Tuning multirotation of 1/4" shaft. Knob not supplied.

Cat. DM-1000



DIRT CHEAP!!

MIDRANGE AND TWEETER LEVEL CONTROL BARGAIN

This unit is designed for midrange and tweeter controls on multiway speaker systems. It is suitable for systems up to 80 watts power handling capacity. It presents a constant 8 ohm impedance to the load, and so does not disturb the crossover points. Unit is fully sealed, mounting plates and is labelled high and mid with rotary controls. Both high and mid are in the one unit, and we can offer these far below the normal price.

Cat. AC-1683

ONLY $9.95

TELEPHONE DOUBLE ADAPTOR SENSATION

Another Jaycar exclusive purchase. Allows you to connect two phones to the one socket. These normally sell for $7.50.

MAY SPECIAL

SAVE 47%

Cat. XT-6020

$3.95 ea

TURN YOUR SURPLUS STOCK INTO CASH!!

Jaycar will purchase your surplus stocks of components and equipment. We are continually on the lookout for sources of prime quality merchandise.

CALL GARY JOHNSTON OR BRUCE ROUTLEY NOW ON (02) 747 2022

6.3 VOLT MES GLOBES

Don't miss this bargain.

OEM's contact Bruce Routley (02 747 2022).

NORMALLY 50 cents ea

THIS MONTH

4 for $1

10 for $2

GORE HILL OPEN UNTIL 4pm SATURDAY

SPEAKER CLOTH

Up until now, if you wanted speaker cloth you had the choice of black or black! We now have available brown speaker cloth, and it's in 2 sizes.

Top quality, acoustically transparent.

Cat. No.	Colour	Size	Price
CF-2751	Black	1m x 1m	$9.95
CF-2752	Black	1m x 1.7m	$13.50
CF-2754	Brown	1m x 1m	$9.95
CF-2755	Brown	1m x 1.7m	$13.50

Solar Powered Exhaust Ventilator

The Sunvent is a high capacity solar cell and DC motor powered fan in a well designed cowling. The cowling has been cleverly designed to keep watter out and back draughts out.

Simply cut a 120mm hole in a bulkhead or deck - or whatever - and the Sunvent will remove stale damp air and cut down mildew growth. It will extract dangerous LP gas or petrol fumes safely as the motor is sealed. The Sunvent is at its best in bright sunlight but will work quite well even on bright cloudy days. It will move about 35 cubic metres of air every half hour in good conditions.

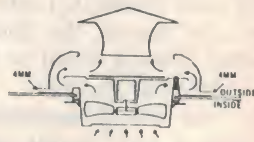
Supplied with cover to turn off cells and stop all airflow.

- Boats
- Caravans
- Port-a-Loos
- Greenhouses
- Sheds
- Holiday homes
- Backyard dunnies
- Kitchens
- Weekenders etc

Cat. YX-2500

$49.95

LESS THAN HALF THE PRICE OF NEAREST EUROPEAN MADE EQUIVALENT!



NEW '88

START YOUR OWN BUSINESS? MAKE A FORTUNE!

One of the great Australian Dreams is to own your own business. Most people dream of it but NOW is your chance to do something about it.

HOW?

We all know that shoplifting and vanalism cost a small fortune very year. It has been demonstrated that television surveillance cameras in the right environment can discourage this activity.

This is where you come in.

We have made a great purchase of realistic-looking Dummy TV Cameras.

They are Australian made, are supplied with adjustable swivel mounting bracket, fixing screws, flashing LED circuit board and 2 flashing LEDs. One red LED is mounted in a bezel on the front of the camera to add reality and the other - would you believe - is mounted BEHIND the dummy cameras lens! It looks really corny when it flashes and you COULD disconnect that LED but if a thief was ignorant of the cameras operation it may make the camera look more realistic to him. Also supplied is the 2 x D cell nylon battery holder to power the flasher circuit. A fake cable wallplate is also supplied as well as a very conspicuous 210(W) x 160(H) self adhesive sign which says "THESE PREMISES ARE PROTECTED BY TIME-LAPSE ANTI-THEFT CAMERAS" The text of the sign is in orange-red fluorescent ink against a black background.

You can start your own business by installing these devices in your area. Liquor shops, service stations, car parks, other shops in fact anywhere where the proprietor of a business has a security problem.

Dummy TV Cameras generally sell for about $90 each PLUS installation. By using your skill as an electronic enthusiast you could MAKE A FORTUNE by SELLING AND INSTALLING this camera for less than the cost of a normal camera. You could easily double your money every time you sold and installed a camera!

BUT HURRY! We have around 300 of the cameras at this below normal manufacturers price. We do not ever expect to be offered simillar stock again.

Just imagine! You could earn a WEEKS WAGES on a Saturday!

We have special bulk prices for installers at the one-off price you can make heaps!

Cat. LC-5310

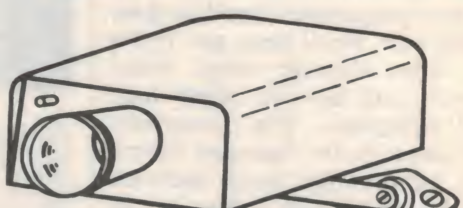
1 - 4 pieces ______ $49.95

5 - 9 pieces ______ $42.95

10 - 19 pieces ___ $39.95

20+ pieces ______ $37.95 each

THE BARGAIN OF THE YEAR



DUMMY CAMERA BARGAIN

WIRE WRAP WIRE

Now available in 2 sizes in 5 metre lengths. High quality US made wire wrap wire in 24 and 28 guage. Both green in colour.

Cat. WW-4350	24 guage	$2.95	5 metres length
Cat. WW-4365	28 guage	$2.95	5 metres length

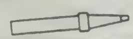
WELLER TIP SALE

We have a small quantity of tips to suit the Weller W60D and W100D 240 volt temperature controlled soldering irons.

Weller No.			Cat. No.	Qty Avail
CT5BB8	2.4mm	427°	TS-1390	11
CT5CC8	3.2mm	427°	TS-1391	54
CT5DD8	5mm	427°	TS-1392	103
CT5EE8	6.4mm	427°	TS-1393	41

These would normally cost about $11 each. Because of the small quantities, you'd better be quick.

ONLY $4.95 each



EL CHEAPO DESOLDERING BRAID

Our usual desolderwick is sold in a plastic spool and contains 5 feet for $2.50. That's approximately $1.50 per metre. El cheapo braid is 2mm wide and will take solder off a PCB reasonably well although the braid gets a bit hot because there is no plastic spool to hold. You could easily put some in your old spool. Supplied in a 5 metre length for $2.50. That's 50– metre - or 1/3rd the price of normal desolderwick.

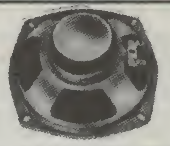
Cat. NS-3025 5 metre pack

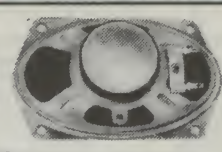
Please note: braid is not loaded with flux and will not work quite as well as normal desolder braid.

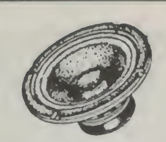
$2.50

ANOTHER SCOOP PURCHASE

Hi Quality Speakers at Silly Prices







This is your chance to grab some high quality speakers at prices well below normal. They are made in New Zealand.

5" WIDERANGE
5 watt 8 ohm
Cat. AS-3020
$3.95 ea
10+ $3.65 ea
100+ $3.25 ea
NORMALLY $8.95 each

5" WIDERANGE
7 watt 8 ohm
Cat. AS-3021
$4.25 ea
10+ $3.95 ea
100+ $3.50 ea

5" WIDERANGE
10 watt 8 ohm
Cat. AS-3022
$5.95 ea
10+ $5.50 ea

5" WIDERANGE
15 ohms
Cat. AS-3011
$3.95 ea
10+ $3.65 ea

6" x 4"
8 ohm
Cat. AS-3014
$4.95 ea
10+ $4.50 ea
NORMALLY $10.95 ea

8" TWINCONE
10 watt 4 ohm
Cat. CE-2322
$8.95 ea
10+ $8.00 ea
NORMALLY $13.95 ea

8" TWINCONE
20 watt 4 ohm
Cat. CE-2323
$13.95 ea
10+ $12.95 ea

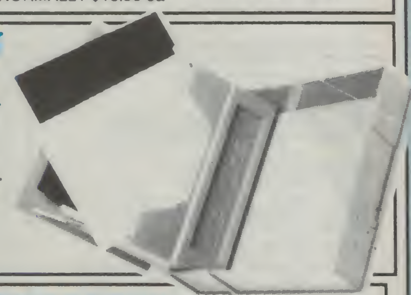
5.25" DISC SENSATION

Another unbelievable scoop purchase by Jaycar. We have available a quantity of US brand "Discimate" 5.25" SSDD discs. They are supplied in a handy plastic box of 10 which opens to allow easy access to discs. The box has one of the best opening actions we've seen. We can offer a 5 year warranty. These discs are so cheap we can only sell them in boxes of 10.

Cat. XC-4751

ONLY $13.95 box of 10

$12.95 10 or more boxes each.



MAGNAVOX 6 WATT WOOFER/MIDRANGE

Another new addition to our range of Australian made Magnavox woofers. Suitable as a woofer or a midrange.

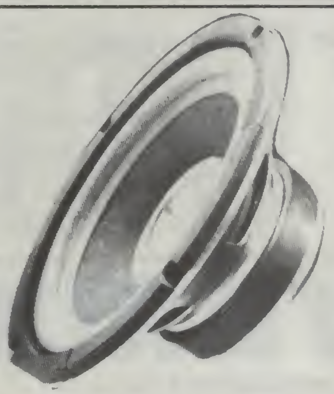
Power Handling	40 watts RMS
Freq. Response	50 - 6500Hz
Resonant Freq.	55Hz
Voice Coil Dia.	25mm
Sensitivity 93dB	

Will give excellent results as a midrange in the frequency range 500Hz - 5kHz. Needs to be mounted in a sealed enclosure of 2-4 litres. Will handle 60 watts RMS as a midrange.

SPECIAL INTRODUCTORY PRICE

Cat. CW-2107

$19.95 ea



6" x 2" SPEAKER!!!!

Yes, a 6" x 2" speaker, that's 157 x 57mm. The size may be strange, but the quality certainly isn't. They are Japanese made, with a large magnet. It even has a foam roll surround. These were used in colour TV's, so the quality is excellent. Sanyo brand 8 ohm 5 watt. Limited quantity. These would probably cost $30 as a spare part!!

Cat. AS-3020

$4.95 ea **10+ $4.50 ea**

2-Wire AC Mains 7.5 Amp Flex

This cord has a moulded 2-pin (i.e. no earth) approved plug with a very generous 3 metres of flex stripped and tinned at the end.

Ideal as a replacement lamp cord or any long cord that need not have an earth.

Worth $3.95 **THIS MONTH $2.00**

Cat. PS-4112

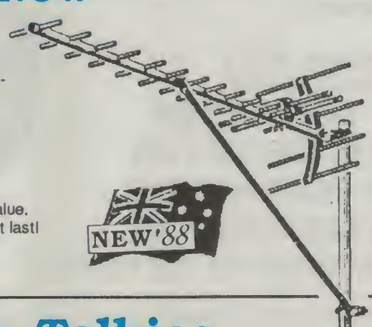
UHF Antenna - BUY NOW

Massive scoop purchase of quality Japanese-made (DX Antenna Co.) high gain UHF antenna! (ch28-63). This 14 element unit has incredible front to back gain and would be suitable for "fringe" UHF areas. (Gain 7.5 - 11.5 dB depending on actual frequency). The boom measures 1.2 metres long is even fitted with a diagonal support strut for extra ruggedness. Not only that, this antenna is fitted with a 300/75 ohm weather proof balun as standard! (You can use either 300 ohm ribbon or 75 ohm coax).

This antenna is priced about 50% below its true retail value. We have less than 200 so be quick! At $39.95 they wont last!

Cat. LT-3176

ONLY $39.95



FRIGI-FRESH

Refrigeration Deodoriser

DIRT CHEAP!!

Battery powered, were $24.95 last year.
A few left at $9.95. A great Mothers Day gift.

Cat. YF-5522

ONLY $9.95

Spare filters
Cat. YF-5523 Only $1.00

BARGAIN Walkie Talkies

- Good range
- includes AM radio
- includes Morse key transmitter
- Morse code symbols on the front panel of each unit
- Solidly constructed
- 7 transistor, 2 diode design
- Low current drain (25mA standby)
- Nifty belt clip included

Cat. DW-3040

$29.95 A PAIR

DIRT CHEAP!!

UNIT MAY VARY TO ONE SHOWN

AND NEW PRODUCTS

INTELLIGENT MODEM PRICE SLASHED!!

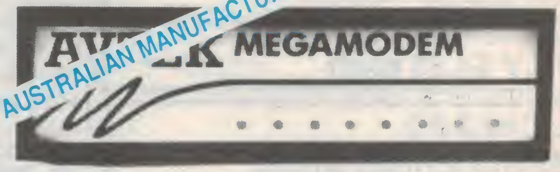
A very well known Australian manufacturer of modems came to us with a problem. They had a smallish number of their No.1 selling intelligent modems left from their final production run. (The product was being discontinued because their upgraded 1988 model intelligent modem is fitted in a smaller more attractive case. They were anxious to clear the old stock to make way for the new. To be frank, however, there is a snag even though it is in reality a very small snag. What is it?
HAYES COMPATIBILITY. "Hayes" command protocol is used by the intelligent modems to communicate with each other. The problem is that this intelligent modem only uses a subset of the Hayes command protocol. (This can be likened to IBM 'Clone' type computers. Most are not 100% IBM compatible. They work well anyway). Mind you, the above is only a problem if you were say, a bank or large corporation trying to use this modem to receive information at high speed from their intelligent modems!
BUT if you use it as an ORIGINATE modem, i.e. as a house use/hobbyist etc., it is perfect WE GUARANTEE THAT.
This is a wonderful opportunity to buy a high speed (1200 baud FULL DUPLEX) modem with auto dial/auto answer FOR THE PRICE OF A LOW SPEED DUMB MODEM!
REMEMBER the only drawback is that it will not ALWAYS work with 'smart' software but will always work in the terminal/Viatel mode.
We have purchased this product FAR BELOW manufacturers factory cost. Massive savings are being passed on. This price is 1/2 the price shown in our 1987 catalogue. A condition of purchase was that we did not reveal the manufacturers name, but you can always make an AVerage guess!
SPECIFICATIONS: • Speeds 300 baud full duplex, 1200/75 limited full duplex 1200 baud full duplex (option)
• Data standards CCITT V21, CCITT V23, Bell 103, CCITT V22 (option) Bell 212 (option) • interface CCITT V24 (RS232) • Data format Asynchronous • Diagnostic Analogue and digital loopback • Filtering digital, no adjustment crystal locked • Power 240V AC • Modulation Frequency shift keying phase shift keying (with V22 option) • V21/V22/V23 (1200/1200 option fitted)
Cat. XC-4834

SAVE OVER 50% WAS $699

NOW ONLY $349

DIRT CHEAP!!

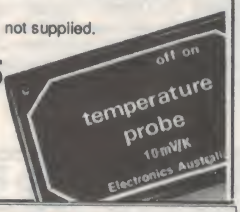
FAMOUS AUSTRALIAN MANUFACTURER



Low Cost Temperature Probe for Multimeters

Ref: EA January 1988
This is an easy to build temeprature probe which adapts a multimeter or electronic voltmeter into a general purpose thermometer. Prototype was tested from -20° to 120°C at 1% accuracy.
Aluminium tube not supplied.
Cat. KA-1696

$19.95



30 + 30 Watt Stereo Amp

INCLUDING PREAMPLIFIER

Fully built and tested with separate bass, treble, balance and volume controls. This superb amp has less than 0.1% distortion. There are inputs for microphone, phono and auxiliary (line) and all power supply components are on board. Just connect a transformer, speakers and a signal - and away you go! Requires 36-38VAC x 2.
Size: 186 x 145 x 40(H)mm
Cat. AA-0300

Transformer to suit
Cat. MM-2010
$22.50

$69.95

200 WATT 3 WAY CROSSOVER

- Crossover frequency 500, 3500Hz
- 12dB attenuation
- 200 watts RMS
- 8 ohms

Cat. CX-2621

$69.50

TEXAS TI-56 CALCULATOR RUNOUT

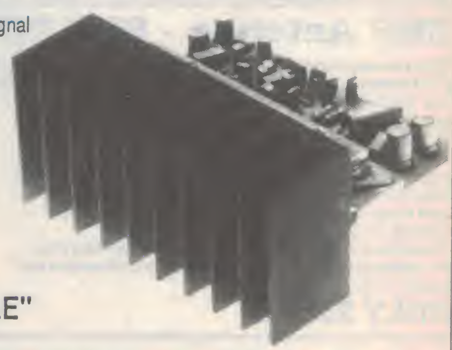
This is a true programmable scientific calculator at the price of a cheapie!

NORMALLY $49.95
THIS MONTH
$39.95
Cat. QC-7174

JAYBRIK

Instant power pre-built amp module made in Australia and GUARANTEED TO WORK.
Complete with quality diecast heatsinks. Just add DC power, a signal and a speaker and you are away!
SPECS:
100 WATTSRMS into 8 ohms Cat. AA-0382
50 WATTSRMS into 8 ohms Cat. AA-0380

50 WATTSRMS - NORMALLY $99
SAVE 25% THIS MONTH ONLY $75
100 WATTSRMS - NORMALLY $125
SAVE 20% THIS MONTH ONLY $99
"JAYCAR GIVES POWER TO THE PEOPLE"

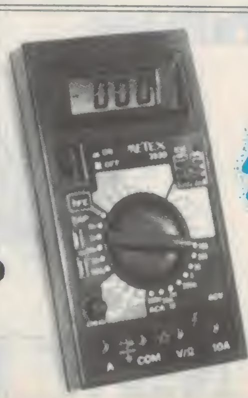


10 Amp Digital Multimeter + Transistor Tester + Capacitance Meter

- 0.5" high digits
- High quality probes supplied
- LED and buzzer continuity test
- Precision thin film resistors for long term stability
- CMOS logic Y 1,000 - 2,000 hours battery life
- Meter protection fused
- Complete with battery and spare fuse
- Floating decimal point
- Auto polarity
- Vinyl carry case

Cat. QM-1540

NORMALLY $129
THIS MONTH
LESS $20
ONLY $109



DIRT CHEAP!!

Motorola KSN 1038

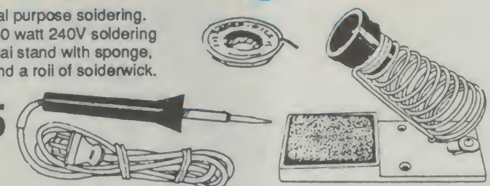
Over 100 watts rms, frequency 4 - 30kHz. No crossover required. Especially suited for Hi Fi.
For size see 1988 Catalogue.
Cat. CT-1914

$18.95

Jaycar Soldering Kit

Designed for general purpose soldering.
This kit includes a 30 watt 240V soldering iron and quality metal stand with sponge, a length of solder and a roll of solderwick.
Cat. TS-1850

$31.95

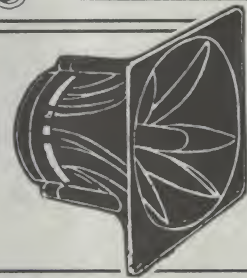


MOTOROLA KSN 1135

This unit which is very similar to our CT-1910 handles 75 watts rms and has an SPL of 96dB. Replace those Asian copies with the original for less cost! No crossover required.
For size see our 1988 Catalogue.

Cat. CT-1908

ONLY $14.95



MOTOROLA KSN 1016

50 x 125mm exponential horn has a full 90° horizontal dispersion angle. With harmonic distortion of less than 1%, this unit is ideal for Hi Fi use. Frequency range 3 - 30kHz ±3dB. Maximum Input 25V rms and no crossover is required.
For size see our 1988 Catalogue.

Cat. CT-2026

ONLY $22.95

MOTOROLA KSN 1025A

A 50 x 150mm rectangular horn with the widest frequency range of the piezo horns.
No crossover required.
Cat. CT-1912

ONLY $29.95

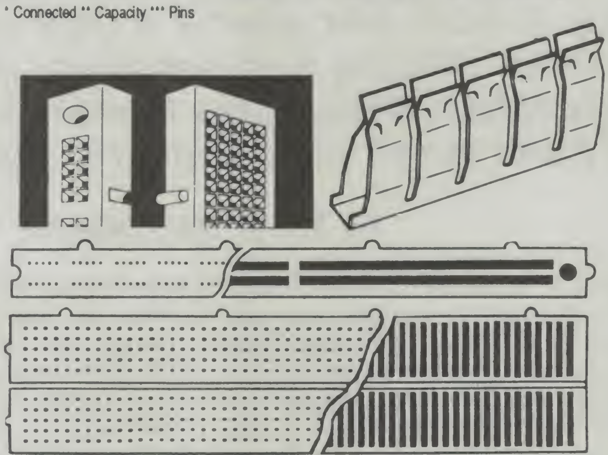
Breadboards

Jaycar breadboards are a convenient and economic way to build circuits and test parts without soldering. Components can be then reused many times.
Made from ABS Polymer. Internal contact terminals are made of alloy of silver and nickel and then plated. Resistance is under 1 milliohm at 1kHz. **LIFETIME GUARANTEE**

Breadboard Specifications

Cat No	Length	Width	Weight	Tie Points	5 Con* Term	25 Con* Bus	Binding Post	IC Cap** 14***	Price
PB-8810	172	13	10	100		4			$3.75
PB-8812	172	39	10	640	128			9	$10.75
PB-8814	172	65	10	840	128	8		9	$17.50
PB-8816	224	150	20	1680	256	16	3	18	$39.95
PB-8818	240	195	2	2420	384	20	4	27	$57.50
PB-8820	264	240	21	3260	512	28	4	36	$69.95

* Connected ** Capacity *** Pins



NEW KITS FOR MAY - FROM THE KIT LEADERS

MADE IN AUSTRALIA

NEW '88

OPTICAL TACHOMETER

Ref: Silicon Chip May 1988
Check the rotational speed of objects remotely with this project. Ideal for cars, model planes, fans, rotating shafts etc. The Jaycar kit comes with all specified parts case, etc.
Cat. KC-5031

ONLY $49.95

SIMPLE TESTER FOR POWER TRANSISTORS

Ref: EA May 1988
Previous magazine projects can't really check power transistors properly. This project kit can and is extremely simple. It will measure current gain and Vbe of all popular power transistors - even Darlingtons!
All project specified parts in the kit.
Cat. KA-1700

ONLY $22.95

RF DETECTOR PROBE

Ref: EA May 1988
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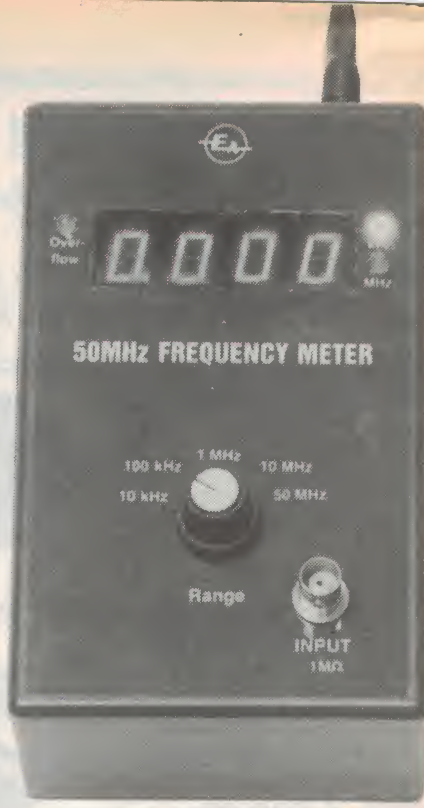
Build this low cost

50MHz Digital Frequency Meter

Here's the latest in our line of inexpensive, easy-to-build test gear: a 4 digit frequency counter. Offering high sensitivity and input impedance, it measures to well over 50MHz. All parts mount on a single PC board.



by MARK CHEESEMAN

Of the frequency counter designs we've published in the last few years, almost all have aimed to provide as high a frequency capability and resolution as possible. Our 500MHz design published in December 1981 and February 1982 has proven to be a popular kit for this reason.

However, in common with other high-performance designs published of late, it uses several rather expensive integrated circuits. While these devices make the design and construction of a frequency counter much simpler than would otherwise be possible, the asking price of $75 to $80 for the display driver chip alone has made it hard for many people to justify the cost of such a kit. In contrast, the total cost of the parts in the design presented here amounts to little more than the price of this IC alone!

Our new design differs from the 500MHz design in two main respects. Firstly, its nominal maximum frequency is 50MHz instead of 500. This saves on the cost of an expensive ECL prescaler. Unless you are a VHF/UHF radio buff (or have extremely good hearing!), this is unlikely to be a major handicap. The vast majority of signals most experimenters are likely to want to measure are well below 50MHz.

Actually, the prototype counts accurately to well over 70MHz, although the actual figure which is ultimately obtained will depend on the performance of the first prescaler stage.

The second main difference is that the number of digits in the display has been reduced from seven to four. This allows the use of a much cheaper counter and display chip. Four digits still gives more resolution than most digital multimeters, and it is possible to deliberately overrange the instrument by two or three ranges (depending on the frequency actually being measured) to see the less significant digits. This still effectively gives a six or seven digit display, even if it isn't quite as convenient. But, considering the money which you have saved, it is not really much of a problem.

The word *counter* in the name of the instrument is derived from the way in which it measures frequency. A digital counter simply counts the number of cycles which occur in a given time period. If this time period is one second, then the count accumulated in the counter is equal to the frequency of the measured signal in Hertz.

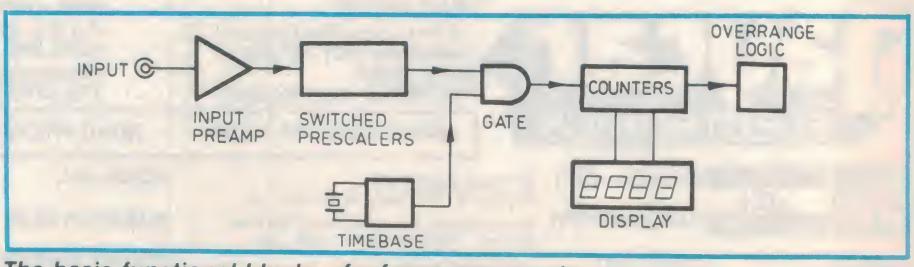
However, a gating time of one second is not the only one which can be used. A tenth of a second makes for an even faster updating speed on the display. The trade-off here is that the maximum resolution now becomes 10Hz. Since the four digit display limits us to this figure on all but the bottom range anyway, we might as well use a tenth of a second gating time on these ranges. Also, as will be shown later, it is possible to obtain a six digit resolution on the three higher ranges, and five digits on the 100kHz range, by simply rotating the range switch back a notch or two.

Circuit details

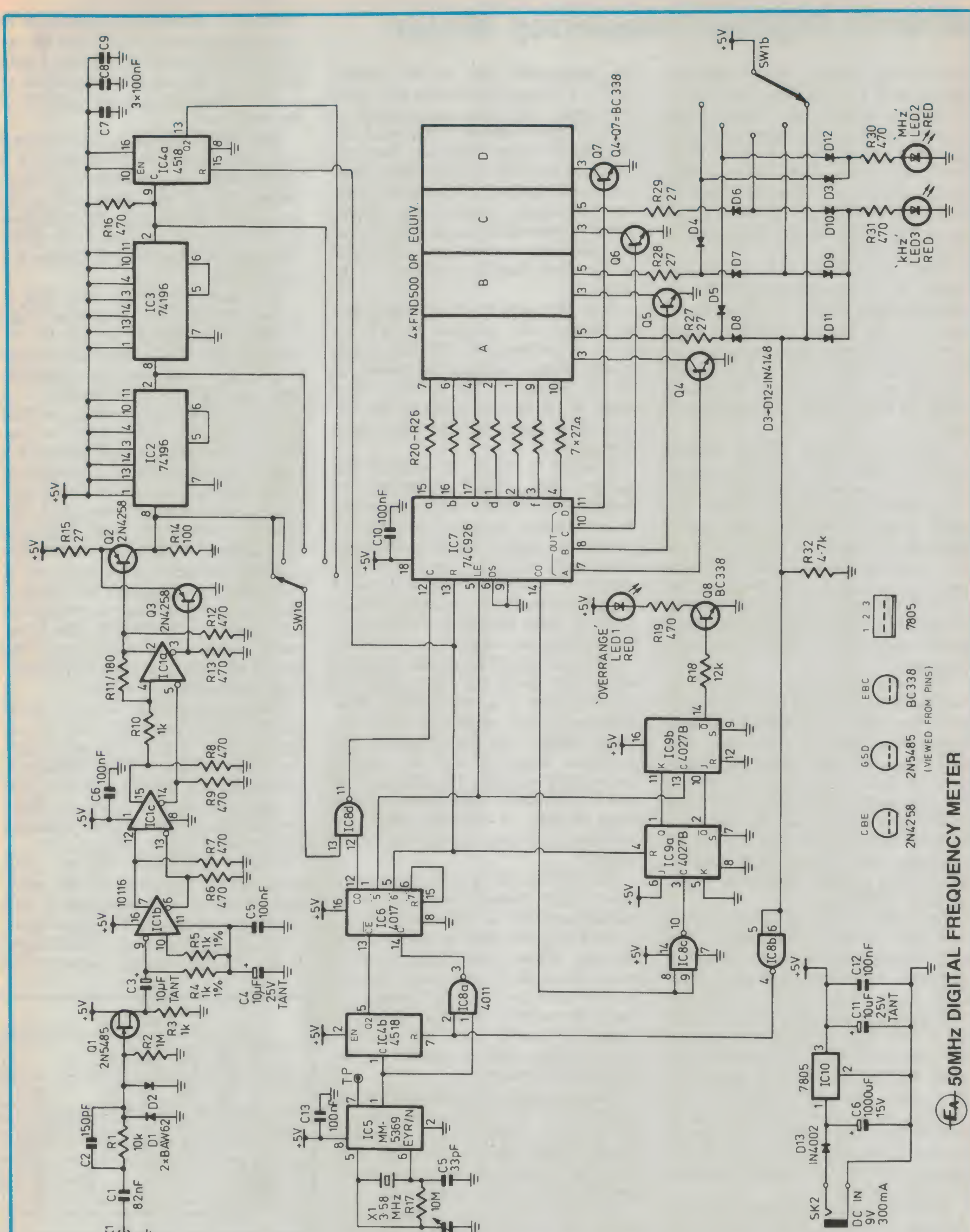
Although the circuit may seem complicated, it is easy to understand how it works if you break it down into sections, and analyse them separately. Fig.1 shows the basic block diagram of the counter.

The main timebase is derived from a 3.579545 "NTSC TV colour-burst" crystal. These are quite cheap, due to mass production for US and Japanese television receivers. IC5, an MM5369 EYR/N, contains an inbuilt crystal oscillator, requiring only an external crystal and a couple of capacitors to complete the circuit. It also contains a factory-programmed 17 stage divider, to divide the crystal frequency down to 50Hz.

IC4b is a BCD (binary-coded deci-



The basic functional blocks of a frequency counter.



50MHz DIGITAL FREQUENCY METER

The circuit uses no expensive or hard to get components.

50MHz Digital Frequency Meter

mal) decade counter, which divides the output of IC5 by a further factor of 10, bringing it down to 5Hz. However this is only true if its *reset* input is tied low (according to the state of IC8b). If the reset pin is taken high, all the outputs of the counter are taken low. However, at the same time, pin 2 of IC8a is also taken high, allowing the 50Hz signal to bypass the divider.

Thus, we have one of two situations. Either the Q2 output of IC4b is low, and the output of IC8a is a 50Hz square wave, or the output of IC8a is high, with a 5Hz signal coming from the output of IC4b. This turns out to be rather convenient, as the *clock* and *chip enable* inputs of IC6 (a 4017) are interchangeable.

IC6 is a five stage CMOS Johnson decade counter. The ten main outputs (Q0 to Q9) are each taken high for one clock period, one after the other. The other output, called the carry-out, is taken high when any of Q0 to Q4 are high, and low otherwise. This IC is used here as a sequencer, repeating a pre-set series of operations at a rate determined by the clock signal applied to it. These signals control IC7, which is the main counter IC.

The 4017 (IC6) may be clocked by holding the chip-enable pin low (it is an active-low signal) and pulsing the clock input, or by tying the clock input high and pulsing the chip-enable pin. Therefore, all that is necessary is to connect the Q2 output of IC4b to the chip-enable pin of IC6b, and the output of IC8a to the clock pin, and IC8a to the clock pin, and IC6 will then count at either 50Hz or 5Hz, depending on the position of SW1b.

The carry-out pin of IC6 (pin 12) is held high for five clock cycles, after which time it goes low again. Thus, it is high for a period of a tenth of a second if the clock input is 50Hz, or one second if the input is 5Hz. This takes pin 12 of IC8d high, allowing the output of this gate to reflect the state of the other input. Because the carry-out signal from IC6 *gates* the input signal to the counter, its period is called the *gating period*. Thus, the counter has a gating period of 1 second on the lowest frequency range, and 0.1 seconds for all of the higher ranges.

When the sixth clock pulse arrives on the input of IC6, the carry-out pin goes low, and simultaneously the "5" output goes high (since the count actually starts at zero, not one). This is connected to the *latch-enable* pin of the counter (IC7). A falling edge on this pin causes the count which has accumulated in IC7's internal counters to be loaded into the display latches, which are also contained in the chip. If the displays were connected directly to the counters without intervening latches, the display would be unreadable as the count would be continually updated at a rate equal to the clock frequency applied to the chip.

Once the count has been loaded into the latches, the counters in IC7 are reset, in readiness for the next gating period. This is achieved by connecting the '6' output of IC6 to IC7's *reset* input. IC4 then resets itself on the seventh clock pulse, and the whole cycle starts again.

In order to obtain the required frequency range, while maximising the resolution on a given range, it is necessary to switch in several divider (or prescaler) stages as required. Switching between the first two ranges is accomplished by selecting either a 0.1 or 1 second timebase, as described above. Thus, no input prescaling is used on either of these two ranges.

ICs 2 and 3 are TTL decade counters, which each divide the input signal applied to them by a factor of 10. These components can operate at up to beyond 50MHz, and thus determine the maximum frequency that the project can reliably measure. The other half of IC4 is also utilised. This gives a total of three decades of division, which are switched in or out one by one as required.

The 74C926 (IC7) contains a complete 4 digit counter, with multiplexed outputs to reduce the pin count. Fig.2 is a block diagram showing what's inside this chip. When a reset signal is applied to pin 13 of the IC, all of the internal counters are reset, and will proceed to count the number of pulses which are applied to pin 12. This will continue until a falling edge is detected on the *latch-enable* pin (pin 5).

This causes the count currently in the counters to be loaded into internal latches, from where they are displayed on the LED displays. After this happens, the counters are once again reset, and the whole process is repeated.

The four seven segment displays are driven directly from IC7, with the corresponding segment anodes of each display connected together. The combination of segments which are to be illuminated for a given digit is presented to the segment outputs of IC7, and the appropriate digit output is also taken high, turning on the transistor connected to it, thus taking the common cathode of that digit low.

Each digit is illuminated like this, one at a time. Provided this is done at a rapid enough rate, persistence of vision ensures that all four digits seem to be on at once. In this chip, the multiplexing is done at a rate of about 1kHz. This is much faster than the human eye can perceive.

If a count of greater than 9999 is reached before IC7's counters are reset, a falling edge appears on pin 14, the *carry-out* pin. This is inverted by IC8c to provide a rising edge to trigger the *clock* input of IC9a, a J-K flipflop.

The J and K inputs of IC9a are tied to +5V and 0V, respectively, so that the Q output will go high whenever a clock is applied to the appropriate pin of the flipflop. The Q-bar and Q outputs from this gate are connected to the J and K inputs of the other flipflop in the package (IC9b), which latches the *overrange* indication at the same time as the latches in the counter are clocked. The first flipflop is then reset along with the counters in the 74C926. The Q-bar output of this second flipflop drives the base of Q8, which turns on LED1 to indicate the overrange condition.

Note that no damage is caused to either the circuit under test, nor the frequency meter when an overrange condition exists. In fact, it is by deliberately overranging the counter that you read the values of the less significant digits, provided the maximum input frequency of the counter chip is not exceeded.

In order to increase both the sensitivity and the impedance of the input, some form of pre-amplification and buffering is necessary. The input circuit is virtually identical to the 50MHz input of the 500MHz counter presented in

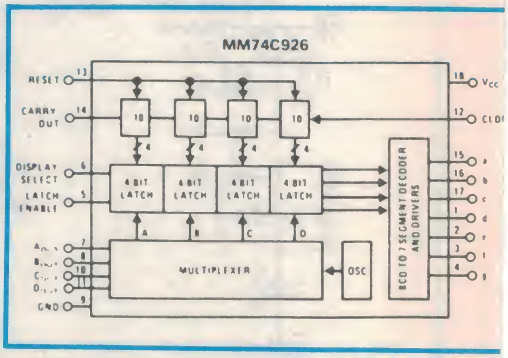
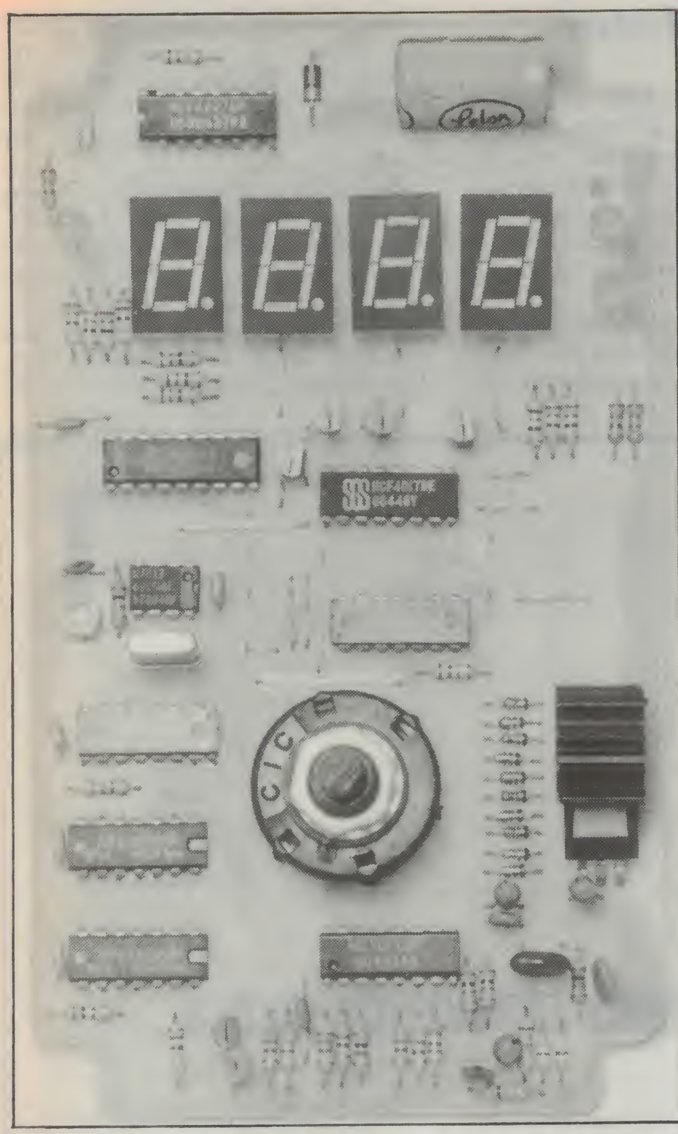
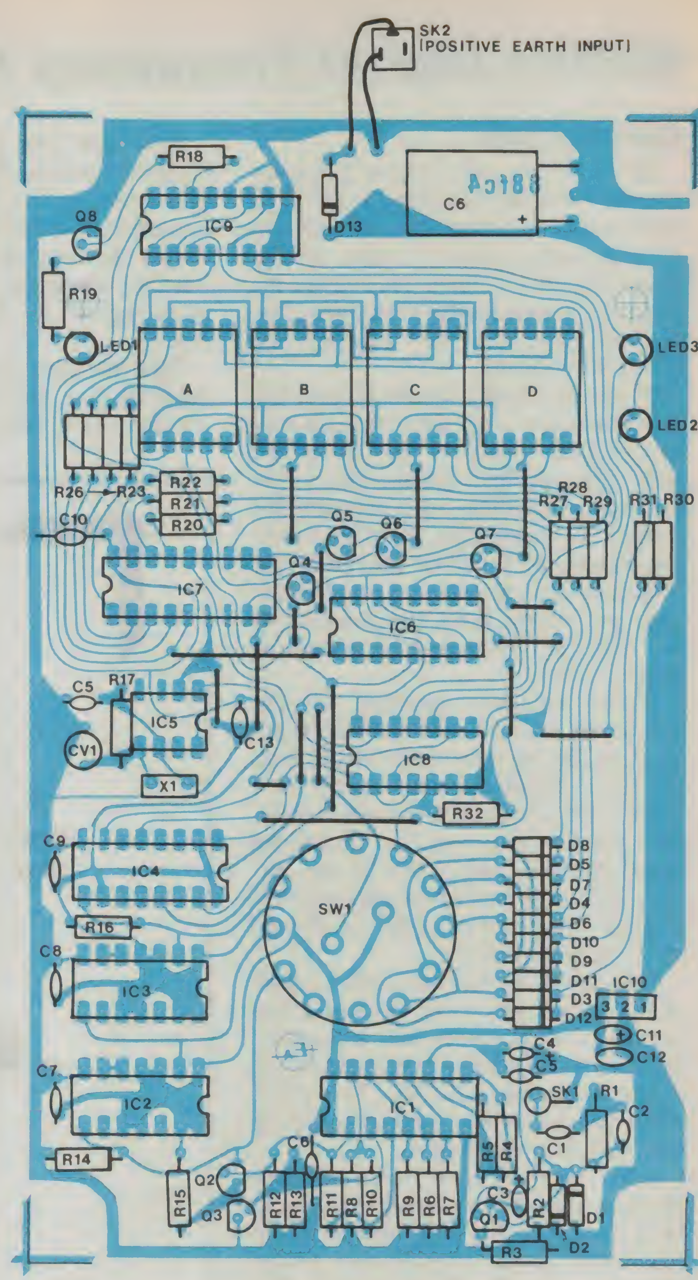


Fig.2 This diagram reveals the secrets of the 74C926, a 4-digit counter and display driver.



The finished product, before mounting it in the box. The 3-terminal regulator may need a larger heatsink than the one pictured here if the plug-pack voltage is a little on the high side.



December 1981. We tried many different types of input stage, but were hard pushed to better the performance and simplicity of the earlier design.

The input is first clamped by the two diodes, D1 and D2, to ensure that large input signals do not destroy the FET which follows it. The FET (Q1) is configured as a source-follower, and serves to provide the counter with a high input impedance. This impedance is determined by the gate-bias resistor, which is 1MΩ.

The FET is capacitively coupled to IC1, a 10116 ECL (emitter-coupled logic) line receiver. This contains three identical stages, the first two of which are used to amplify the signal from the FET input buffer. The third stage is configured as a Schmitt trigger, because of the positive feedback provided by R11. This helps to minimise false triggering due to noise pickup, by introducing some hysteresis.

The differential pair formed by transistors Q2 and Q3 converts the small voltage swings appearing on the output of the ECL chip to the correct levels, for either the TTL divider which follows it (IC2) or the NAND gate (IC8d), depending on the position of SW1a.

Power for the counter is provided from a 9V DC plug pack. This ensures a degree of safety, as all 240V wiring is contained within the plug pack, not within the box of the counter. The DC input first passes through a series diode to protect the devices in the counter from reverse polarity on the supply. There seems to be no standardisation as to whether a plug pack connector should have the positive or negative terminal as the sleeve of the plug: hence the diode. This means that if the plug pack is of the wrong polarity, the counter will simply not work, with no damage to either the counter or the supply.

A 1000uF capacitor (C6) ensures that the incoming DC is relatively free from ripple. IC10, a 7805 three-terminal regulator drops the supply voltage down to the 5 volts required by the counter circuitry. This is then bypassed by C11 and C12, to ensure a low impedance supply at the frequencies which may appear in the circuit. Several other bypass capacitors have been placed close to ICs which may be particularly noisy or sensitive to supply noise, so that internally generated signals (such as the multiplexing oscillator in IC7) do not, say, appear on the input.

50MHz Digital Frequency Meter

Construction

The entire circuitry for the frequency counter (with the exception of the plugpack connector, if used) is mounted on a single-sided printed circuit board, measuring 89 x 153mm. This allows the board to mount directly behind the plastic front panel of a UB1 size jiffy box (150 x 90 x 50mm).

If you are etching the board yourself, take particular care with the exposure and etching times, as the tracks are quite close together in some places. For this reason, anything but a photographic method for making the board cannot be recommended. Whether you make the board yourself or obtain a ready-made one, you should check the copper pattern carefully for unwanted bridges or broken tracks.

Before mounting anything on the board, the corners need to be trimmed to clear the internal pillars in the box. Using the perimeter earth tracks as a guide, drill a large hole in each corner, and carefully cut out the remaining board material using a pair of side cutters. Also drill the two mounting holes, marked out adjacent to the location of the 7-segment displays.

Now insert all the links and resistors in the correct places on the board, followed by the lower-profile capacitors, such as the monolithic bypass capacitors adjacent to some of the ICs. Now insert all of the diodes and transistors, taking care with their orientation.

Next insert the four seven segment displays, again being careful to orientate them correctly. The same applies to the ICs, which may be inserted next, taking due care with the CMOS devices. Finally, solder the rotary switch to the board, making sure that it sits down as close to the board as possible. Do not apply too much heat to the switch pins, as you may melt the plastic body.

Now turn your attention to the mechanical assembly details. First, make a photocopy of the front-panel artwork, and check that the size has not changed during the copying process. Also mark out the rectangular hole for the display, according to the dimensions shown in Fig.3.

Tape the copy of the artwork to the lid of the box, and drill small pilot holes for the LEDs, switch and input socket. Using a ruler and a sharp knife or scalpel, cut around the markings for the display hole. This will leave a mark on the plastic lid, which can be used as a guide for the actual cutting-out of the panel.

Drill a series of small holes, as close together as possible, inside this mark. Remove the unwanted panel material and file the cut-out out to the mark which was made on the panel. Also, enlarge the holes for the LEDs, switch and BNC socket to the correct sizes. Also remove the paper copy of the

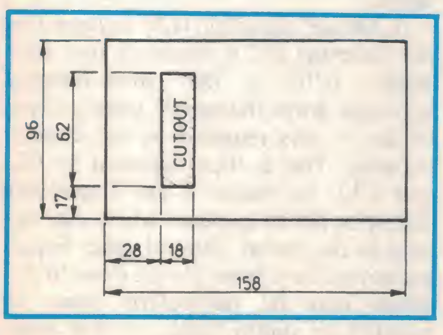
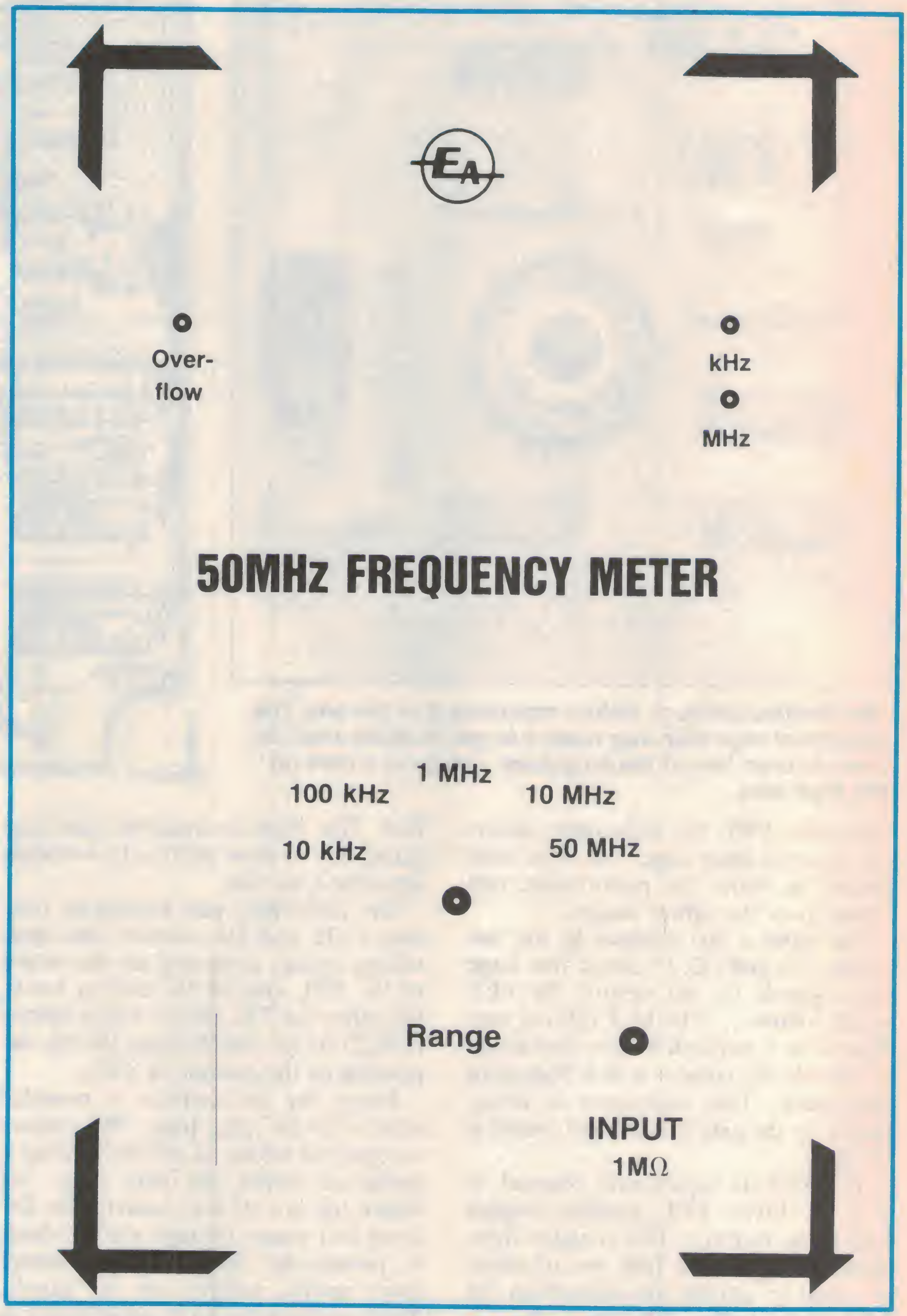


Fig.1 The location and size of the front panel cut-out for the display.



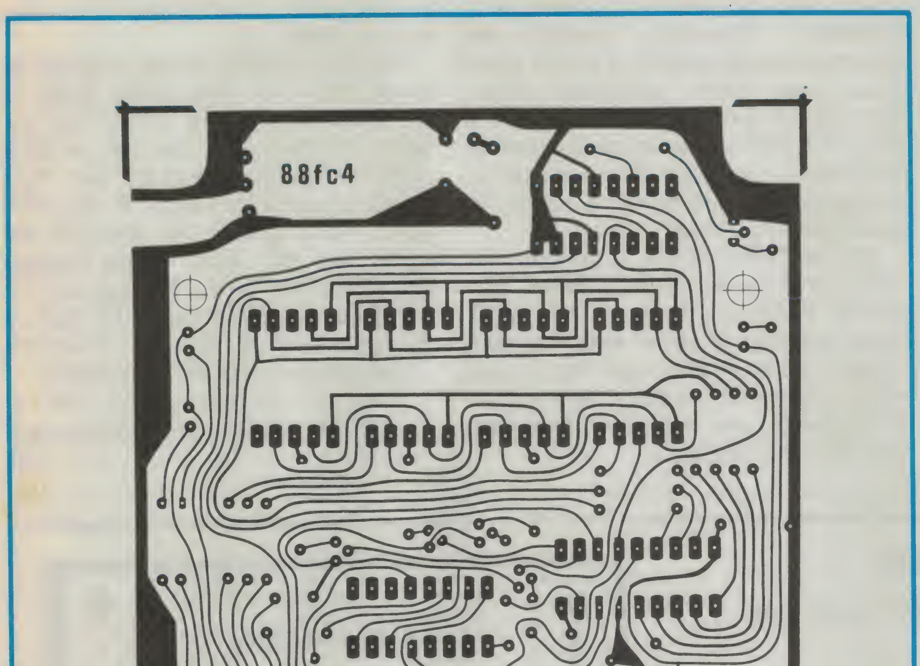
The front-panel artwork, for those who like to 'roll their own'.

front-panel at this point.

Place the assembled PCB in position behind the lid of the box, and align the two so that the display sits properly centered in the appropriate cut-out, and mark out the locations of the mounting holes on the lid using the board as a guide. Carefully countersink the holes, using a large drill bit rotated by hand, so that the mounting screws will lie flush with the surface of the lid and not cause the dress front panel to appear 'lumpy' when it is applied.

Insert a couple of 20mm long 6BA counter sunk screws in these holes, and secure them in place with a nut each. Tighten these nuts well, as the screw heads will be inaccessible when the front panel is fixed in place. Now, carefully attach the dress panel to the lid of the box, making sure to get it right the first time, as the panel cannot be removed without damage once the adhesive has taken hold.

Now, with a sharp implement such as a scalpel, make the holes in the front panel to line up with those drilled in the lid. Insert the BNC socket in the appropriate hole, and tighten the nut on the back. A star-washer between the socket and the panel will ensure good electrical contact between the two, and also help to prevent loosening of the socket. Also, solder a couple of short, stiff



A full sized reproduction of the printed circuit artwork.

Parts List

1 PCB measuring 88 x 152mm coded 88fc4
1 UB1 plastic jiffy box, 150 x 90 x 50mm
1 2 pole, 5 position PCB mount switch
1 knob to suit switch
1 panel mount BNC socket
1 3.579545MHz crystal
1 2.5mm plug-pack socket

Resistors (all 1/5w, 5% unless noted)

11 x 27Ω, 1 x 100Ω, 1 x 180Ω, 10 x 470Ω, 2 x 1k, 1 x 4.7k, 1 x 10k 1 x 10k, 1 x 12k, 1 x 1M, 1 x 10M, 2 x 1k 1%.

Capacitors

1 82nF metallised polyester
1 150pF ceramic
3 10uF 25V tantalum
8 100nF monolithic ceramic ('blue chips')
1 1000uF 25V electrolytic (axial or radial)
1 33pF ceramic
1 4.4-20pF trimmer

Semiconductors

1 74C926 4 digit counter/display driver
1 4518B dual decade counter
2 74196 decade counters
1 4017B Johnson decade counter
1 4027B dual J-K flip-flop
1 4011 quad NAND gate
1 MM5369 EYR/N 50Hz timebase
1 10116 ECL line receiver
1 7805 regulator
5 BC338 NPN transistors
2 2N4258 VHF NPN transistors
1 2N5485 VHF JFET
1 1N4002 diode
10 1N4148 diodes
2 BAW62 high-speed diodes
3 5mm red LEDs
4 FND500 (or equiv) common cathode 7-segment displays

Miscellaneous

6BA countersunk screws and nuts, PCB spacers, red perspex.

wires to the BNC socket to connect to the PCB when this is mounted after calibration.

Although some of the displays which can be used contain an integral red filter, a piece of red Perspex is used in the design presented here. This is because the board is mounted too far from the panel for the displays to protrude through it. A single filter covering the four digits also looks much neater than the separate ones built into the displays themselves. There are two ways in which to mount the filter, depending on your confidence in working with Perspex.

The easiest method is to cut out a rectangular piece of the material a little larger than the hole in the panel (say, 3 or 4mm on all sides), and glue it behind the panel. If you are prepared to invest a little more time, you could trim the Perspex so that it actually fits neatly *inside* the cut-out, and then glue it in place. If this is done carefully, the final appearance can be quite neat and tidy.

The only component which is not mounted on the PCB is the plug-pack socket. If you intend to dedicate a plug-pack to the counter, then it is probably best left off. Otherwise, it is mounted on the top end of the box, but far enough back from the front panel so that it will not hit the PCB when the lid is placed on the box. Solder a couple of pieces of hookup wire between the socket and the DC input pads on the board, being careful of the polarity.

Calibration

No measuring instrument is more accurate than the standard by which it is calibrated. Fortunately, because the counter is crystal-locked, it will be quite close even without calibration. However, if you have the equipment available, it is well worth the extra effort to calibrate it, especially if you intend to *overrange* the instrument in order to gain higher resolution.

The most obvious way to calibrate the unit would be to apply a stable frequency which is just below the maximum frequency of one of the lower four ranges to this counter and also to another of known accuracy, and adjust CV1 until the two instruments both display the same reading.

However a more direct approach is possible, thanks to the MM5369 IC. Pin 7 of this IC provides a buffered version of the actual crystal oscillator frequency. Therefore, simply adjust the trimmer until exactly 3.579545 MHz is read on another (calibrated) counter connected to pin 7.

All of this assumes that you have access to another frequency counter which is already calibrated. If this is not the case, probably the best that can be done is to set CV1 at about mid-range, and leave it there.

The three LEDs should now be inserted into their appropriate holes in the front panel, taking note of the polarity: all three have the flat on their body towards the top of the box. Now attach the completed board to the front-panel, while guiding the wires of the LEDs and the input socket through their respective holes. Put nuts on the two PCB support screws, and also on the selector switch, and then solder the LEDs and input socket to the board.

Your new counter should now be ready to be added to your range of test equipment.

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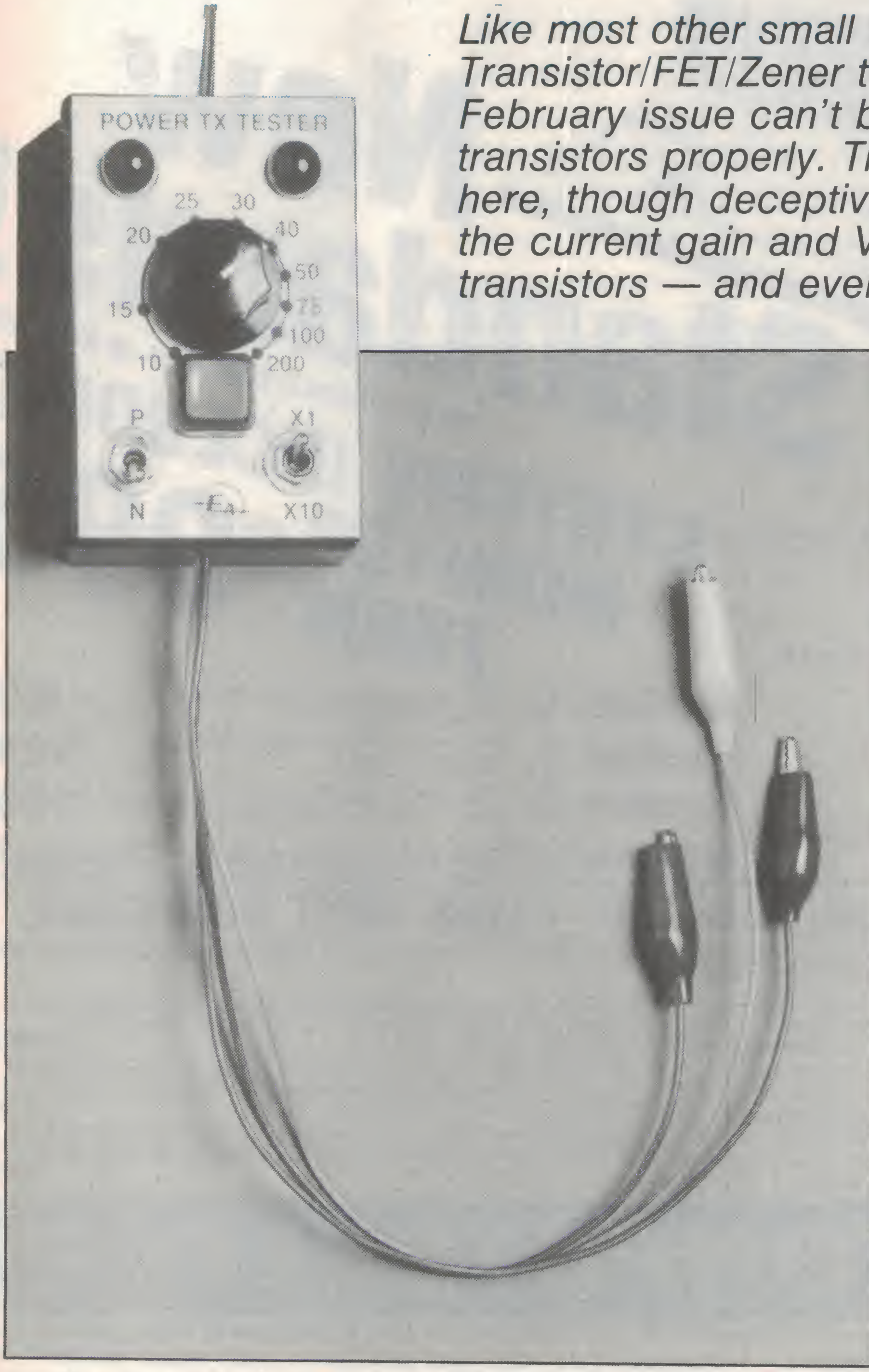
Construction project:

Simple tester for power transistors



Like most other small transistor testers, the Transistor/FET/Zener tester described in our February issue can't be used to check power transistors properly. The tester presented here, though deceptively simple, can evaluate the current gain and Vbe of all popular power transistors — and even power Darlingtons.

by PHIL ALLISON

For the purpose of this article, a power transistor is any bipolar transistor with a continuous collector current rating of at least one amp — although RF types have not been tried. If a transistor has a rating below this, then DO NOT attempt to test it with this tester, as damage is likely.

Now a power transistor (particularly a silicon device) is designed to work at higher current levels, and usually has little or no current gain β or hFE at the low current levels employed by most transistor testers — including the earlier *EA* designs and the one described in the February 1988 issue. As a result, if you try to test them on this kind of tester, you'll get erroneous readings: the device will seem to have much lower gain than its real performance at working current levels.

The tester design presented here operates at a nominal 0.6 amps of collector current, and so eliminates this problem. As a bonus, it provides for testing of a power transistor's Vbe (base—emitter voltage), under the correct conditions of constant Ice (collector—emitter current). You can thus use it for correct matching of devices for parallel operation. It will even allow you to match power Darlington devices.

Because the tester is not likely to be needed all that often in most workshops, I have not included a dedicated power supply. Instead it is designed to

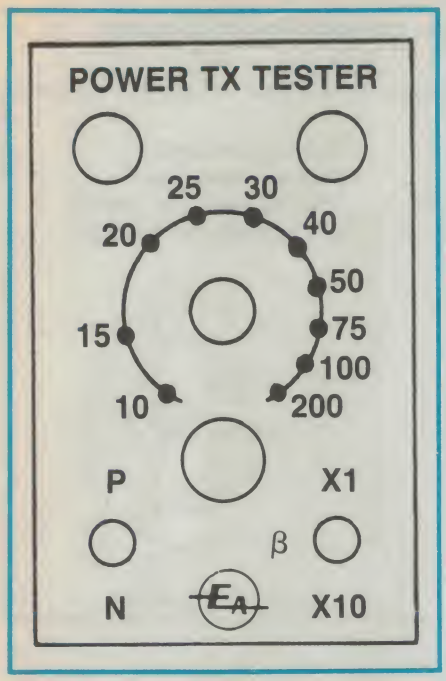


Fig.3: The panel artwork for the original tester, showing the current gain measurement scale.

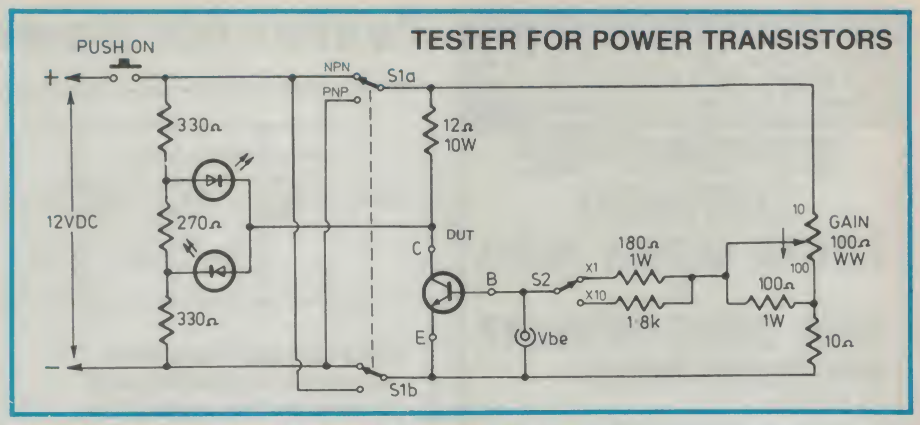


Fig.1: The circuit for the tester is deceptively simple.

Inside the author's prototype tester. The 12-ohm power resistor is cemented to the rear panel, to assist in heat dissipation. No PCB is needed.

use an external 12V DC power supply. A variable regulated bench supply with a rating of one amp or more would be ideal, and most readers with a need for this project are likely to have such a supply. However a 12V plug-pak would also suffice, or even a 12V battery, rechargeable or otherwise.

Principle of operation

The idea behind the design was to test a transistor at a fairly high current, and to measure the base current needed to achieve this current. The ratio of these two is then the β of h_{FE}.

A simple means of setting the collector current to a known value and varying the base current so as to indicate β was devised on paper, tried and optimised. As I have an aversion to unnecessarily complex or expensive gadgets to perform simple tasks, a method of setting the current which does not use a moving coil meter seemed preferable.

Two LEDs can be used as shown in the circuit as a sensitive null detector, to set the collector voltage to a particular value. When the voltage at the collector of the Device Under Test (DUT) is equal to one half the supply, then the voltage across each LED is barely sufficient for it to light. When both LEDs are out, this indicates that correct 'null' has been achieved. If a known supply voltage and collector load resistor are employed then a known current has been set — in this case 600 milliamps. If a pot is used to vary the base current, then it can be calibrated in terms of the current gain of the DUT once the LEDs are nulled out.

The condition of half supply at the collector is enough to null the LEDs and give a correct reading, so the actual supply voltage is not critical. However the design is optimised for 12 volts DC where the LED sensitivity is best and

Parts List

1 case, as desired
1 DPDT miniature toggle switch
1 SPDT miniature toggle switch
1 pushbutton switch
2 LEDs, preferably 'jumbo' size
1 100Ω wirewound pot
1 knob, to suit
Test leads and clips

Resistors ¼W type:
1×10Ω, 1×270Ω,
2×330Ω,1×1.8k
1 12Ω 10W resistor
1 100Ω 1W resistor
1 100Ω 1W resistor

Tester for power transistors

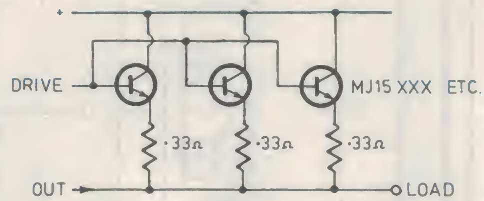
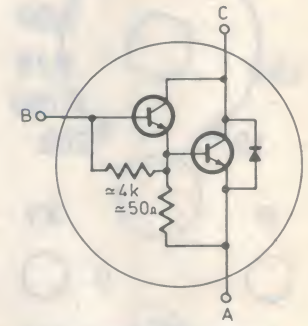


Fig.2 (above): Transistors connected in parallel need to have emitter resistors to ensure current sharing. They should also be matched for Vbe.

Below: Darlington devices often have internal resistors, which can complicate testing.



Darlington type transistors can be read most accurately.

Why measure Vbe?

Often it is necessary to operate transistors in parallel to build up capacity for a high power amplifier or a power supply. The usual technique (Fig.2) is to connect the bases and collectors together while the emitters have resistors in series to aid current sharing and thermal stability (i.e., prevent thermal runaway).

There is a further requirement that the output transistors be 'matched'. Some people (even technicians) think this means matched β, but this is not so. It is necessary to match the Vbe/Ice characteristics of the transistors, to get even sharing of current between several devices. Matching the β will not help, as the Vbe overrides in such a circuit arrangement.

The RCA socket connection on this tester allows a digital voltmeter to be connected to the B-E junction, to check the Vbe when the Ice is 0.6 amp.

Note: Keep the reading brief, as device heating affects the Vbe at the rate of 2mV per degree C, as the temperature of the chip rises.

Note also that most power transistors have some form of 'date code' stamped on them indicating the batch which they came from. Generally speaking devices with the same date code have very similar Vbe/Ice characteristics, so this is usually a good starting place for device matching.

Construction details

There is no PCB specified as all components can be easily wired point to point as with valve circuitry. The pot and switches provide sufficient points to anchor components. I used 'jumbo' LEDs supplied by Davred Electronics of York Street in Sydney, because their size and brightness suited the design well.

Calibration procedure

If the design is followed exactly, the scale shown (Fig.3) will probably suffice. But if you wish, a simple calibration can be done by inserting a current meter in series with the base connection of a good transistor, and read the current for various settings of the pot. If the current is 60mA then this equates to a gain of 10, if 6mA then 100 and all points in between. This assumes that the tester is connected to a supply of very close to 12V, of course.

How to use it

To test a transistor for β it is only necessary to connect the clips to the correct leads and select S2 for appropriate polarity (NPN/PNP). Then while holding the 'ON' button down, rotate the pot to null out the two LEDs.

If no null occurs on the X10 range, switch down to the X1 and try again. If there's still no success, check the connections and polarity. If you still can't get a null the device is probably faulty.

Once a null is found simply read the β from the scale around the pot.

Testing Vbe

To test Vbe connect a DVM to the RCA socket and after setting the tester to null the LEDs, read the DVM. A reading of 0.6 to 0.75 volts is to be expected.

Construction project:

RF detector probe for our Bench Amp

This simple and effective RF probe may be built from a handful of common components. It becomes a sensitive AM signal tracer when coupled to last month's Bench Amp or an audio amplifier.

by ROB EVANS

The simple RF detector probe has quite a pedigree. Its line extends back to the early days of radio, when it was one of the few essential pieces of test gear. When coupled to a small audio amplifier, the inexpensive probe was ideal for troubleshooting AM radio receivers without the luxury (or cost!) of an oscilloscope.

In these days of widely available and reasonably priced oscilloscopes (CROs), we tend to dive for the CRO probe to test any circuit. When tracing through an AM radio for example, the CRO will show us the presence of a signal and its relative amplitude, without significantly loading the circuit.

However, our old friend the RF probe has the advantage of allowing us to actually *hear* the signal as it progresses through the stages. This gives us an immediate indication of the quality and gain of each section, without analysing waveforms. Very 'real time' indeed!

Also, it's unlikely that everyone who troubleshoots or experiments with radio has an oscilloscope, leaving them with little means of tracing through a circuit. In this case, the RF probe is just the shot as a portable, low cost signal tracing tool.

Probing the circuit

The original and most basic form of the RF probe is simply a series connected signal diode, followed by a capacitor across the output. The diode rectifies (or detects) the incoming signal which is then filtered by the capacitor, leaving a voltage that is proportional to the input signal level. Therefore, the envelope of an amplitude modulated (AM) signal may be detected by this circuit, whilst removing the original carrier frequency.

Due to its moderate input impedance, such a simple design tends to load the circuit under test possibly causing it to detune, or stop altogether. Also, the forward voltage drop of the diode means that signal levels of less than this voltage will not be detected.

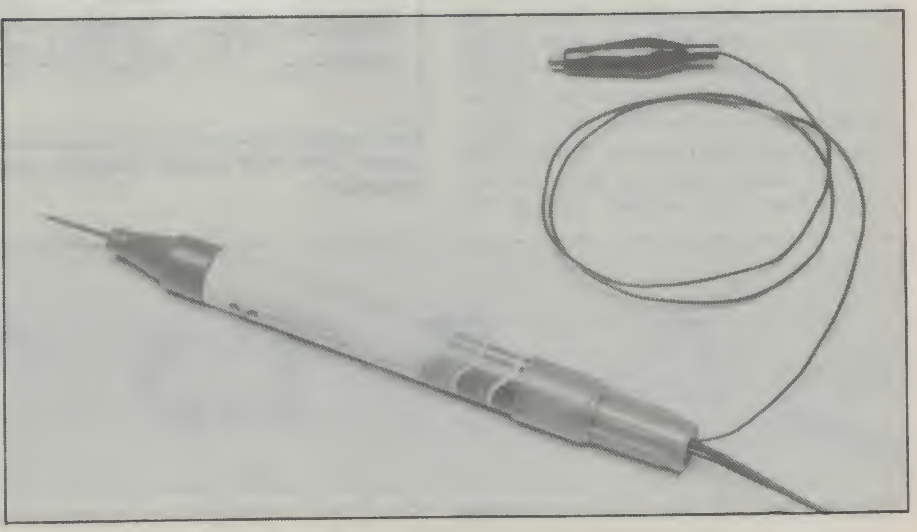
The simplest solution to these problems is to amplify and buffer the RF signal, before it is applied to the detector stage. The circuit now requires a DC power source, but is able to detect quite low signal levels.

Perhaps the most convenient device for this purpose is the common Field Effect Transistor (FET), which offers a high input impedance and moderate gain at radio frequencies. The FET (Q1) in our circuit is arranged as a common source amplifier, with a gain of about 5 (up to 10MHz), and an input impedance of 1.5M ohms as set by R2.

The input signal to this stage is coupled from the probe tip via C1, while the FET is self-biased by R3 and the source bypassed by C2. The 10M ohm resistor R1 provides a DC path for C1; this minimises discharge transients when tracing through a circuit. The amplified RF signal appears across the drain load R4, where it is coupled to the detector stage via C3.

As a further refinement on the basic design, a second diode has been added to the detector stage to form a diode pump style detector. This will provide still more output from the probe, by its voltage doubling action.

Finally, the carrier frequency (remaining RF) is removed by the filtering action of C4, and the resulting audio frequencies (AF) developed across R5. The AF may then be monitored by a suitable amplifier/speaker combination, such as the EA Bench Amp as

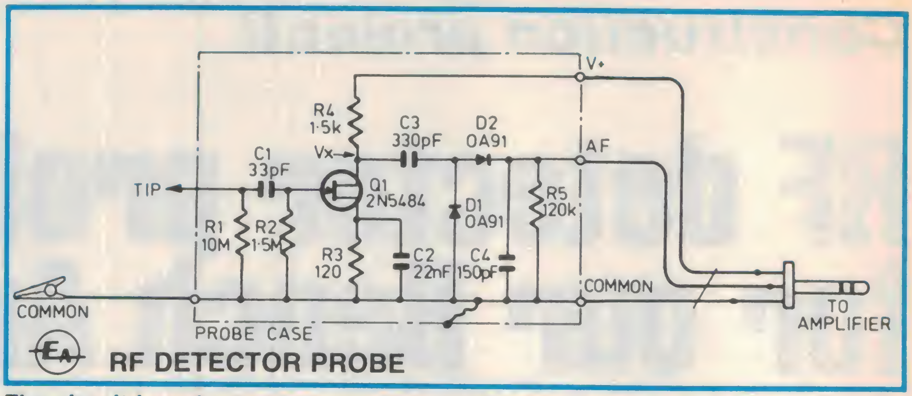


RF Probe

described in the April 88 issue of *Electronics Australia*.

Since the probe is connected to an amplifier via the audio cable, it may be remotely powered by a second wire from the amplifiers power supply. This avoids the size and reliability compromises of battery power.

As a further bonus, since all of the electronics are mounted in the probe itself, the circuit under test can only 'see' as far as the probe input. This eliminates the capacitive effects of long test leads when the detector circuitry is inside the amplifier. In fact, the described probe can have quite a long interconnecting lead without any ill effects.



The circuit is a simple common source FET amplifier, driving a voltage doubling detector.

The hardware

As well as electronic performance, there are physical considerations for a truly useful RF probe. It must easily fit the hand, and be able to probe (hence the name!) between the components of a radio circuit. In fact, the ideal shape is somewhat like a pen.

The case of a readily available fibre-tipped marker pen was too tempting to resist. Not only is its size and tapered point suitable, but the aluminium body may be a convenient RF shield. Naturally, a small amount of drilling and filtering is necessary.

Construction

All of the components are mounted on a small printed circuit board (PCB) coded 88pr5, and measuring 80 x 12mm. This is a snug fit inside a standard marker pen body.

Begin construction by mounting the components on the PCB, while referring to the component overlay diagram. Pay particular attention to the orientation of the FET and signal diodes.

The metal probe tip was salvaged from a discarded multimeter probe, and is attached to the PCB by a short length of tinned copper wire. This wire should be covered with spaghetti or sleeving to provide insulation from the metal case. If the tip does not fit neatly through the moulded plastic end (in place of the original fibre tip), carefully enlarge the hole with a drill bit.

A short length of hookup wire should be connected to the 'case earth' position on the PCB, and about 10mm of the insulation stripped from its end. This exposed wire is wound into the aluminium case thread, and held in place when the plastic end is screwed on, during final assembly.

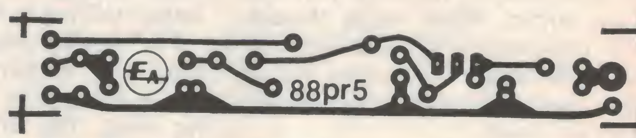
Next, a few simple modifications on the pen body are necessary. The enclosed end of the aluminium case should be opened to allow installation of the PCB. This may be done by drilling holes of ever increasing size, or alternatively cutting off the end carefully with a small metal saw.

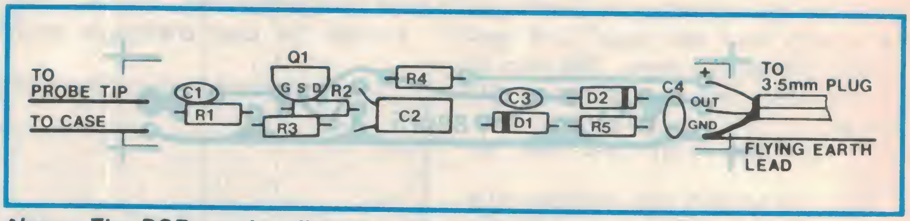
The original pen cap will become the rear cover of the probe, and must have a hole drilled in its centre as a cable exit point. The twin-core shielded cable and a length of hookup wire should be passed through this hole, and attached to the PCB as shown in the component overlay.

Finally, the flying ground lead may be terminated by a crocodile clip, and the twin shielded lead connected to a stereo 3.5mm plug. This plug mates to a 3.5mm socket mounted in the amplifier, which accepts the audio and also provides a DC supply for the probe.

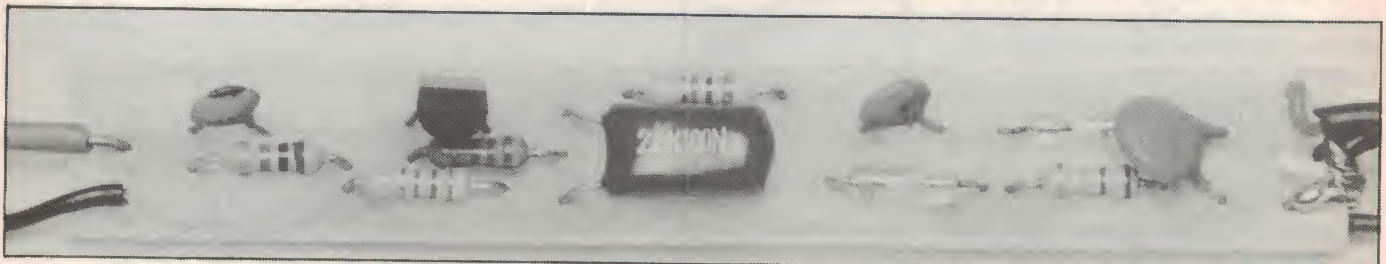
The complete PCB may now be slid into the pen body, and the plastic tip screwed on with the case ground connection. A knot should be tied in the cable to prevent undue stress on its PCB terminations. Also, a small amount of packing may be required when fitting the end cap to firmly secure the PCB/tip assembly inside the case.

Right: The PCB may be built from this full size artwork.

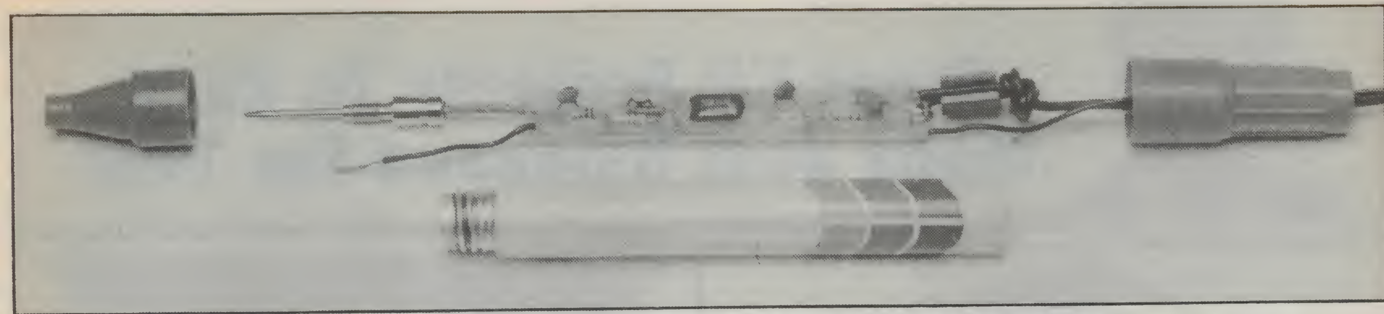




Above: The PCB overlay diagram, showing the component and wiring positions.



A larger than life view of the assembled PCB. Some components may need to be bent over to clear the pen body.



An exploded view of the probe. The original pen cap becomes the end fitting and lead exit point.

The amplifier

A suitable amplifier for the probe signal should have a reasonably high input impedance and sensitivity. The EA Bench Amp easily satisfies these requirements with figures of 1M ohm and 10mV respectively.

There is provision on the Bench Amp PCB for extra power supply decoupling components, which were labelled 'R' and 'C'. With values of 680 ohm and 100uF (25VW) installed respectively, the prototype provided a low ripple supply of about 14 volts for the RF probe. The supply voltage required by the probe is not critical in level, however the ripple content should be as low as possible.

Another addition to the amplifier is the 3.5mm input/power socket. This may be installed in a convenient position, and the signal input terminal (say, the tip connection) bridged to the amplifier's standard input. Naturally, the socket should be grounded, and the filtered DC supply connected to say the sleeve connection.

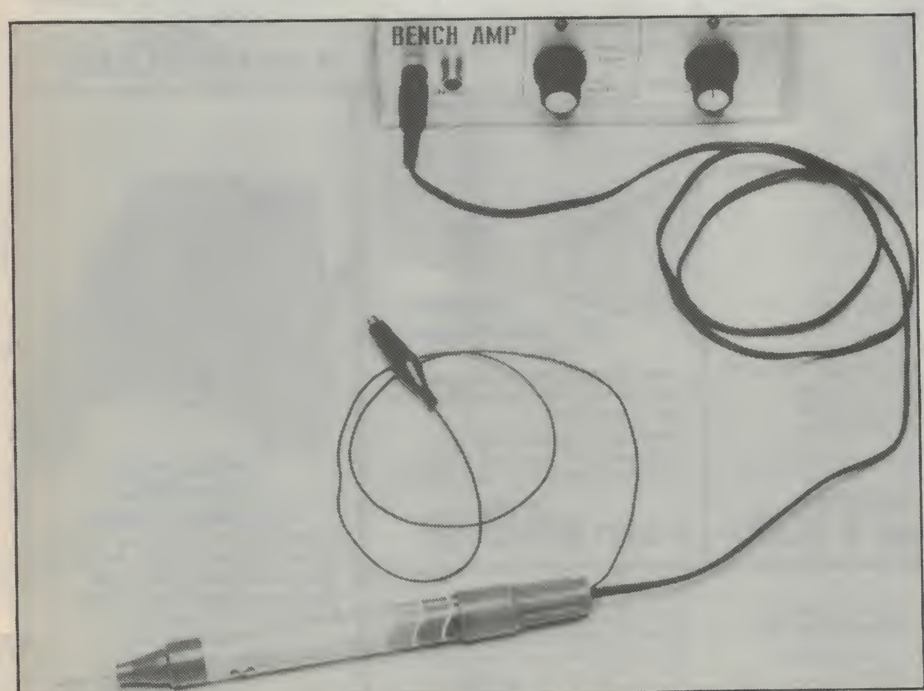
If an amplifier other than the Bench Amp is used, a similiar supply decoupling filter will be required. The same values for 'R' and 'C' should be fine, although the supply may need to be bypassed in the probe itself (try a 22nF metallised polyester).

Testing and probing

A couple of voltage checks can be made on the probe before installing the unit in its case. The DC supply should be between about 10 and 15 volts, and the FET's drain voltage (Vx) between about 1/3 and 2/3 of this value. This type of range is likely due to the wide spread of FET parameters. In extreme cases, the value of R3 may need to be altered to obtain a reasonable level of Vx.

The easiest way to complete the checks on the RF probe, is to trace through the circuit of an AM radio. The probe should be fully installed in its case, and the flying earth lead clipped to a convenient point on the radio's ground. Start tracing at the radio's own detector circuitry and then try a few points in the IF stages.

Finally, the amplifier input could be automatically switched between the two inputs (normal or probe), by using a switched 3.5mm socket. However, switched stereo 3.5mm sockets are quite difficult to obtain. So unless a different (and bulkier) style of socket is used, don't forget to unplug the RF probe when using the amplifier's standard input for normal audio signals.



Parts List

1 fibre tipped marker pen (cleaned and gutted!)
1 PCB, code 88pr5, 80 x 12mm
1 3.5mm stereo plug
1 crocodile clip
1 metal probe tip

Semiconductors

1 2N5484 FET
2 0A91 germanium signal diodes

Resistors (all 0.25W, 5%)
1 x 120Ω, 1 x 1.5k, 1 x 120k, 1 x 1.5M, 1 x 10M

Capacitors

1 33pF ceramic
1 150pF ceramic
1 330pF ceramic
1 22nF metallised polyester

Miscellaneous
Twin-core shielded cable, hookup wire, tinned copper wire, plastic sleeving.

Additional parts for Bench Amp

1 x 680Ω resistor, 1 x 100uF (25VW) PCB mount electrolytic capacitor, 1 x 3.5mm stereo socket.

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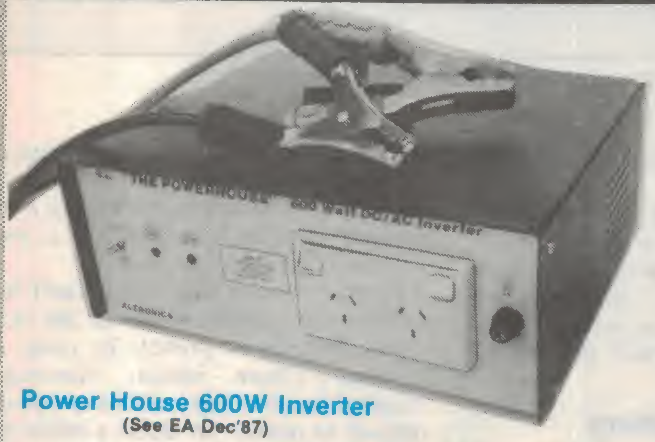

Power House 600W Inverter

(See EA Dec'87)

Go Anywhere 240V Mains Power rrom your car or truck battery with these fantastic DC to AC Inverters

A must for farming, camping, mining, boating, remote settlements and wherever else 240W power isn't available.

Features: Strong custom steel chassis • Industrial grade power coat finish • Can be configured to operate off either 12V and 24V DC • Very little internal wiring • Manual or Auto start facilities • Low battery cut out • Compact Toroid transformer.

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K 6770	K 6774	K 6775
KIT VERSION	12V INPUT	24V INPUT
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300 Watt Inverter With Auto Start

Operates From 12V Car Battery

Features: Auto start draws power from your battery only when appliance is plugged in and "turned on" i.e. battery can be left permanently connected if required. • **Voltage regulated** • **Current Regulated** • **Current Overload** unit self limits — Single PC Board construction — easy to build as there is very little internal wiring.

Complete Kit — **K 6750 $279.00**

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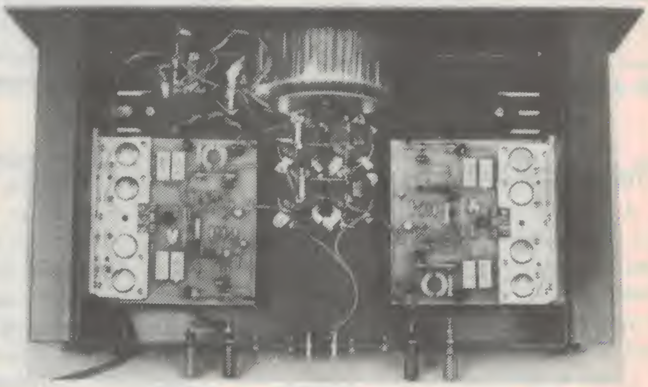

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AC/DC Millivolt Meter

(See EA Dec'87)

Precision measure critical circuits

Designed to cause minimal circuit loading whilst reading very low level voltages.

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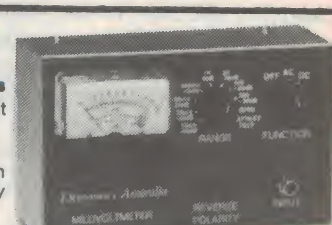

K 2670 $55.00

Transistor FET Zener Tester

(See EA Feb/Mar'88)

New updated circuit incorporates facilities for testing transistor FETs and Zeners etc.

Features: • Gain • Leakage • Breakdown Voltages • Zener Voltage • Polarity — NPN/PNP

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Controls the temperature of your standard soldering iron. Suitable for irons rated from 20W—75W Standard soldering iron plugs straight in, no need for modifications.

(See EA Sept'86)

K 6400 $39.00

Car Alarm

(See EA Aug'86)

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Now our top selling Car Alarm. Two Sensor inputs—Normally open and normally closed enable simple connection to door, bonnet, Boot light, switches etc.

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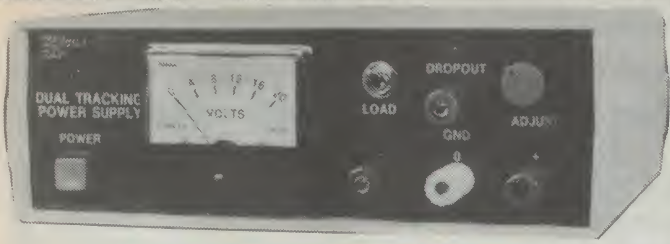

Low Cost Dual Tracking Supply

(See SC Jan'88)

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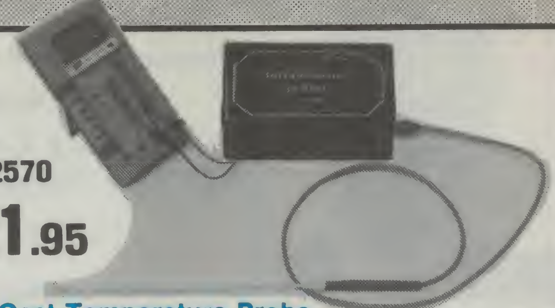

K 2570

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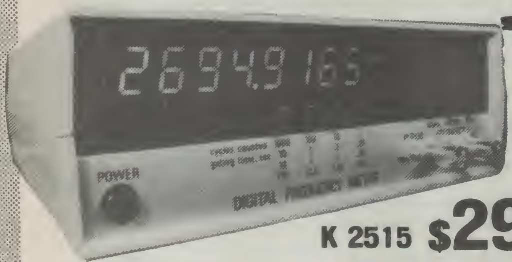
Low Cost Temperature Probe

Here's an easy to build probe design which adapts a multimeter or electronic voltmeter into a general purpose thermometer. It's just the shot for measuring heatsink temperatures, how hot it gets inside your car, or whether little Johnny has a fever!

Measures accurately from -20 deg.C to +120 deg.C.



Congratulations To The Design Team At Sillicon Chip Magazine for this Excellent Design

K 2515 $299.00

1GHz Digital Frequency Meter

(See SC Nov'87 Jan'88)

This superb 1GHz Frequency Meter will out perform many other instruments twice its price.

Features: Professional machined and screen printed red perspex front panel • Easy to asemble and construct • No special tools required • Bright Hewlett Packard 8 digit display • Electronic switch latching • High performance IC's • High Quality Components.

T.V. Colour Bar and Pattern Generator

(See EA Oct'87)

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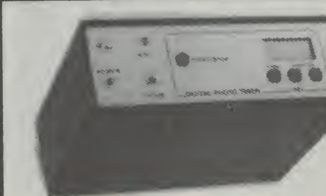
Ideally suited to T.V. repairs and amateur television production.

Features: 8 patterns to choose from
- PAL or NTSC compatible
- Operates on Channel 1
- Horizontal sync output • Vertical sync output • RF Output.

Housed in rugged "ABS" instrument case.

K 2700 $179.00



Digital Photo Timer

(See EA Aug'86)

Precision time your Processing with this Low Cost Project

This classy digital timer allows precision timing for photographic processing from 1 second up to 9 minutes 59 seconds in 1 second increments.

GREAT VALUE

K 1850 $85.00

Capacitance Meter Adaptor

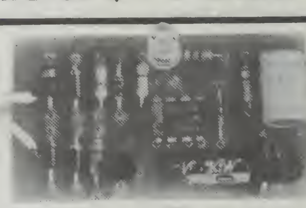
(See SC Nov'87)

Great for hand selecting exact values e.g. exact values for timer circuits etc.

It allows measurements up to 2.2uF Plugs directly into your meter via. in-built banana plugs.

Suits Labtech Q 1075

K 2520 $24.99



K 1400 $9.95

Telephone Off Hook Indication

(See SC Nov'87)

Use where 2 or 3 phones are connected on the one line. If one extension is in use a LED will flash in each of the other extensions. Requires no external supply. Runs off the telephone line. One module required for each phone.

Regenerative Radio

(See EA Jan'88)

Step back in time and build this simple regenerative radio receiver. Using only 3 transistors, its not only fun to build, but uses Varicap tuning.

K 1150 $55.25

Door Minder

(See SC Feb'88)

This project will sense a door opening in a large or small room and will sound a two-tone chime. It does not have to be anywhere near the doorway as it uses an ingenious sensor to detect the pressure change caused when the door opens. Ideal for use in shops, offices, doctors surgeries, Chemists etc.

K 1915 $45.00

Large 7 Segment Display

This large 153mm high seven segment display can be configured for use as either common anode or common cathode. Multiplexed on DC driver and arranged to have a decimal point on either the left or right handside.

It can be used to interface equipment with existing displays for large elapsed times & digital clocks.

K 1225 $59.95

Low Ohms Adaptor For Your DMM

(See SC Feb'88)

Measure Accurately Down To 50 Milli Ohms!

As we all know it's difficult to obtain accurate resistance measurements below 50 Ohms or so with conventional multimeters. This natty little adaptor plugs directly into your DMM via. in-built banana plugs enabling quite accurate measurements to 50 Milli Ohms and less. Full instructions provided.

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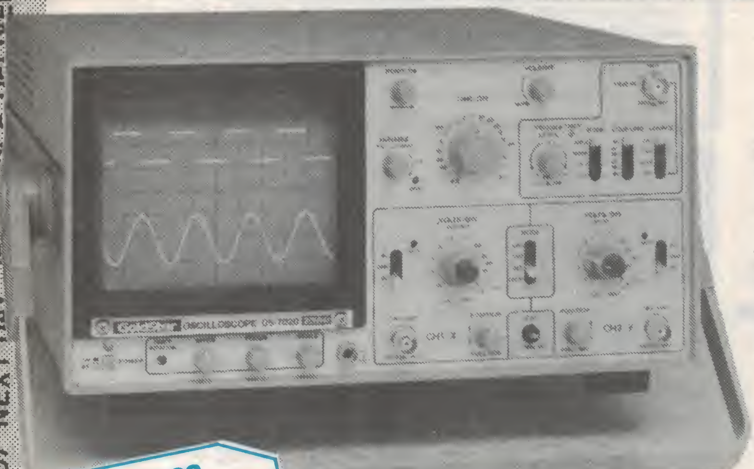

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Dual Trace 20MHz Oscilloscope

This all new CRO must be the best valued quality Oscilloscope in Australia!

This new model is a 20MHz dual-trace Oscilloscope using a high brightness CRT with an illuminated scale. The vertical amplifiers have high sensitivity 1mV-5V/Div. The unit has LED's to indicate when the controls are in the 'uncal' postion, and to indicate if the trace has been triggered. The brilliant triggering circuit will trigger on just about any waveform applied. The highest triggering sweep is 0.2uSec/Div. The Q 0120 also features a 'Hold Off' control for seeing the front end of the input wave form.

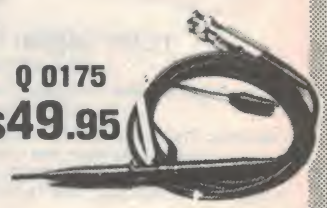
Features: Large 6" rectangular CRT with internal graticule. • High sensitivity: 1mV/Div. • High accuracy: + or -3% • Stable, low-drift design • 8 divisions of displayed dynamic range and accurate distortion-free waveform measurements • This instrument has a special TV sync separation circuit for quick measurements of video signals • A convenient X-Y operation mode allows phase difference measurements between two waveforms.

Full 12 Months Warranty

CRO Probe Sets

High quality LABTECH Oscilloscope probes. Ideal for use with the Q 0120 Oscilloscope. Suits all other brands: 1:1 or 10:1 Attenuation.

Q 0175
$49.95



1 GHz Frequency Counter

This new addition to the LABTECH range will astound you with its high accuracy and stability. A truely Professional instrument that will perform brilliantly in the workshop, laboratory, university etc.

Specifications: The pertinent specifications for the Model Q 1530 are listed as follows:-

1. **Measuring Mode - Frequency Measurements - Channel A** • Range: 10Hz to 10MHz direct counter 10MHz to 100MHz prescaled by 10 • Resolution: Direct counter: 1, 10, 100Hz switch selectable - Prescaled: 10, 100, 1000Hz switch selectable. • Gate time: 0.01S, 0.1S, 1S switch selectable • Accuracy: +/-1 count +-time base error x frequency. **Channel B -** • Range: 100MHz to 1 GHz • Resolution: 100Hz, 1KHz, 10KHz switch selectale • Gate time: 0.027S, 0.27S, 2.7S switch selectable • Accuracy: +/-1 count +/-time base error x frequency. **Period Measurements (Channel 4) -** • Range: 10Hz to 2.5MHz • Resolution: 10-7S, 10-S switch selectable • Accuracy: +/-1 count +/-time base error x period. **Totalize measrements (Channel A)** • Range: 10Hz to 10HMz • Resolution: +/-1 count of input. **General -** • Display: 8 digits, 7mm red LED display with decimal point, gate, overlow, KHz, MHz and uS indication. • Check: Counts internal 10MHz time base oscillator • Power requirement: Line: 115/230V +/-15%, 45Hz-70Hz Internal Battery: Option • Temperature: Rated range of use: -5 deg. C - +50 deg. C — Storage and Transport: -40 deg. C - +60 deg. C • Humidity: Operating: 10-90% RH. Storage: 5-95% RH.

Superbly Engineered

Q 1530 $499.00

Audio Frequency Generator

Often in testing audio circuitry it is necessary to have an accurate and adjustable audio signal source available. This little generator even allows you to test 455KHz IF stages

Specifications: Freq.Range 10Hz - 1MHz **Accuracy** +/-3% +2Hz **Output Waveforms** Sine/Square **Output Level** Sine : 8V RMS Square : 10V P-P **Output Attenuator** -20db, -40db and fine adjust.

New Model For '88

Q 1550 $229.00

RF Signal Generator

An RF signal generator is an absolute necessity when it comes to radio servicing. With provision for both internal and external modulation, this generator is a winner.

Specifications: Freq.Range 100Kz - 150MHz in 6 Ranges **RF Output Level** 100mV RMS **Accuracy** +/-3% **Modulation:-** Internal (30% depth) 1KHz • External - 50Hz - 20KHz • Crystal Locked Oscillator

New Model For '88

Q 1540 $249.00

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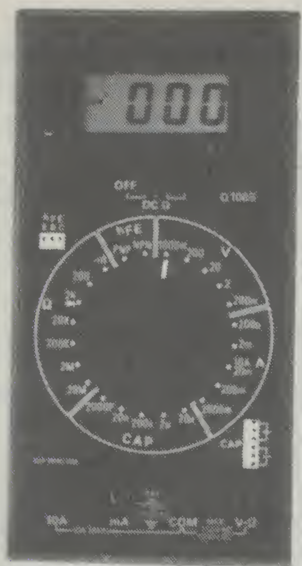
Digital Multimeter With Built-In Capacitance Meter

Not only do you get all the normal ranges of current, resistance and voltage - but also a convenient and simple to use capacitance meter in five ranges. And as if that's not enough, you also get a transistor tester. Check the features of this top quality new addition to the labtech range.

General:

Display: 3½ digit LCD, 0.5" height, with polarity & L0-BAT indication. **Overrange Indication:** 3 least significant digits blanked. **Maximum common Mode Voltage:** 500V peak. **Operating Environment** 0 deg to 50 deg. C; less than relative humidity from 35 deg C to 50 deg. C **Power:** 9V alkaline or carbon-zinc battery. **Battery Indicator:** Display indicates "L0-BAT" when less than 20% of life remains. **Dimensions, Weight** 170mm x 87mm x 42mm, 350grams.



Q 1085 $139.00

Free Carry Case This Month

Normally $12.50

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UV Eprom Eraser

erase your EPROMS quickly and safely. It will erase up to 9 x 24 pin devices in about 40 mins. for 9 chips (less for less chips) • Erase up to 9 chips a time • Chip drawer has conductive foam pad • Mains powered • High UV intensity ensures thorough erase • Engineered to prevent UV exposure • Long Life UV Tube.

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100W Continuous Power rated 150W Max. Intermittent. Massive 1.4Kg Magnet. 8 Ohm.

C 3070 $99

Solar Cell Module .4V at 450mA

X 0210

Normally $5.98

This Month $4.50

10 or more $4.00 ea

Solar Charger

Charges 4 X AA Cells

A 0230

Normally $14.95

This Month $10.00

DC Brushless Fan

120MMx120MMx38MM Brushless, Electronically Commuted DC Motor

Voltage	24V DC
Current	330mA
Speed	3100 RPM
Air Flow	23 C.F.M.
Noise Level	32 dbA

Normally $29.98

This Month

F 1040 $24.00

6 or More $20 ea

High Performance ALC Wireless Microphone

Our incredible ALC Mic is one of the most exciting products for '88. Wireless Mics suffer from overmodulation distortion with too higher input sound level making them unsuitable for high grade vocal entertainment use of ALC (Automatic Level compressor) fixes all this.

SPECIFICATIONS:

• Cardiod-Uni Directional Pick-up pattern • Freq.Res.: 30Hz-15KHz • Carrier Frequency.Adjust Range: Within +1MHz, 88-108MHz. Built-in Antenna

C 0328

Normally $129.00 Amazing Value $99.00

AMAZING PRICE $149 OFF!

A 1510

Normally $399

Microprocessor Controlled Detector Clips On To Sunvisor

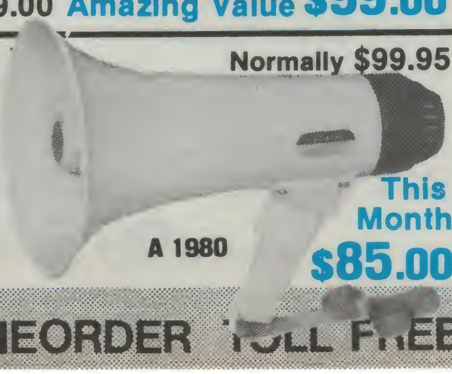
World Famous Microeye Detector

This super compact "Sunvisor Clip On" Microeye Detector is virtually invisible from the outside of most vehicles at normal eye height hence its very unlikely yours would attract the attention of a thief (or the Gendarmes for that matter) However, please remember that use of Radar Detectors is not permitted in some states.

This Month $250 — Be Quick

Professional 15 Watt Megaphone PA

Ranges: 300M approx
Power: 8 X AA cells not supplied (order separately 2 of Altronics S 4970)



Normally $99.95

A 1980

This Month $85.00

Super Bargain 1/2 Price
Fantastic Negative Ion Generator

There have been volumes written about the benefits of negative ions combating air pollution, cigarette smoke etc. can be very beneficial to Asthma sufferers. Our great little Rover generates billions of ions per second! Includes tester.

Were $79.00

This Month

A 0990 $39.00

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Just Imagine a Security/Alarm System you can install in about an hour — Uses no Wiring or Cables and Costs Less than $1 for the Mounting Hardware

UHF 305MHz Microprocessor Controlled Wireless Security System

Commercial grade, quality alarm systems are expensive - Just phone one of the "Name" security firms and get a quote for your home - our estimate is that it will be anything up to $1,000 just for the equipment - **then there is the installation** - countless holes punched through walls, miles of wiring and a day or two of installers labour and **that's around $35 per hour these days. Hardly worth the effort it it? After all what have you got to loose? - Only the Video Player CD Player, Camera, Hi Fi, TV, Jewellery and so on!!**

Well all that is now changed - with our brilliantly engineered Home Guard Wireless Security System Read On —

Take It With You If You Move

Apart from the flawless operation of the Home Guard System—One of the great features is its application with rented or leased premises—Lets face it, money spent on installing a wired system in your Home or Office, Factory etc. is irrevocably lost when you move on. With the Home Guard you simply take it with you.

This alarm system is a brand new design that features completely wireless connection to all accessories, even the reed switches. Think of how easy it is to install a "Wireless" alarm system. The benefits are endless, e.g. arming your Flat or Townhouse with an alarm you don't need to run wires through the roof or drill great holes through your walls. When moving house the alarm is simple to dismantle and re-install elsewhere.

The system divides protected areas into either perimeter zone or internal zone, programmable by dip switches in each transmitter/detector. **Pocket remote control** can simply arm or disarm your house perimeter from your bedside when retiring etc. this allows essential protection while cancelling internal zone as desired. Each transmitter/detector unit can be programmed into interior or perimeter zone. Zones can be programmed for instant or delayed trip. The system has a built-in ear piercing siren for intrusion and panic alarm signals

System Is Comprised Of :

Main Control Receiver

S 5265 $349

Features:

- Wireless reception of external or internal sensors or detectors.
- Selectable home or away modes for selecting internal and external arming or just external to allow movement inside the building
- Built in Piezo electric siren gives different signals to indicate different functions.
- Sends signal down power line to activate one or more remote sirens.
- Programmable Arm/Disarm switch buttons.

The main control receiver runs on 240V AC with a 12V 1.2AH battery for emergency backup. All other units with the exception of the line carrier, run on a 9V battery each. The average life expectancy is approximately one year. System works around the 305MHz frequency where there is less chance of false alarm. The range of the unit is normally 80 metres in open space.

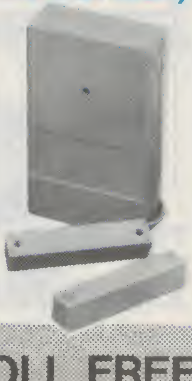
Alarm and Indication Sounds

Intrusion Alarm — Panic Alarm — Arm Tone — Disarm Tone — Exit Click Tone — Monitor Tone — Tampering Alarm.

Detector/Transmitter Unit (Reed Switch)

Suitable For Windows and Doors

This consists of an enclosed reed switch and compact UHF transmitter and a removable enclosed magnet. The unit is at rest when magnet and reed are side by side (within 25mm or 1 inch). When the magnet is moved away more than approximately 1 inch the alarm signals to the Main Control Receiver and the alarm is sounded. In practise the Reed/Transmitter is mounted on the door or window frame with the magnet on the moving door or window.



S 5270 $55.00

Passive Infra Red Movement Detector

Ideal for the lounge room, family room or hallways e.g. anywhere where an intruder is likely to pass through. Mounts up on the wall or on top of bookshelves etc. Detects movement within an area of 9M by 9M by sensing intruder body heat movement through the protected area Should not false trigger with the family cat or curtain movement etc. — as is the case with the cheaper Ultrasonic alarms.

S 5280 $129.00

Remote Piezo Siren

This unit is an optional line carrier receiver. Receives signal through 'AC' line i.e. it would ideally be located in, say, the roof space and plugged into mains power.

S 5290 $125.00

Complete System Special Package Price

One	S 5265	Main Controller
One	S 5270	Reed Switch
One	S 5280	Passive I/R Detector
One	S 5285	Wall control unit.

Including Batteries

This Month $499

S 5260 Normally $570

Accessories

Note: For larger installations your system may well require several Reed switches, movement detectors and 2 or more sirens. Also the remote door controller and or pocket remote controls could be very worth while accessories. The fantastic thing about the Altronic system is you simply add more detectors as you discover the need — no wiring, no expensive technicians, no modifications to equipment.

Hand Held Control Transmitter Unit

A real joy to use — keep it at the bedside table — allows you to, say, arm the house perimeters when retiring or you can take it with you when you go out, arming your system after you lock the door. Unit is a function control transmitter — to send 4 different signals.

Off — To disarm the system before entering. **Home** — To instantly arm the system with 'Perimeter' detection only. **Away** — To arm complete system after a given exit delay time of about 40 seconds. **Panic** — To start an emergency signal whenever needed, in any mode.

S 5275 $59.00

Front Door Keypad Control Unit

This handy accessory virtually duplicates the function of the Master Controller unit but at a more convenient location i.e. just inside your entry door etc. System can thus be armed or disarmed without the need to go to Master unit. Especially handy for larger homes or offices.

S 5285 $99.00

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Make Your Own Chassis Boxes, brackets,etc. Unique slotted upper clamping bar allows complex corner bends

Save Over 30%

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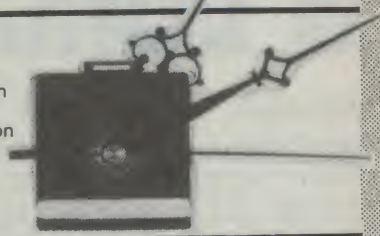
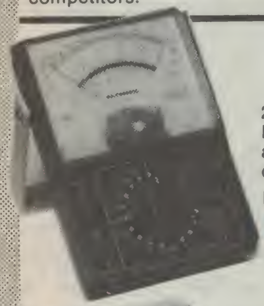
Fit your own custom clock face. Great for novel applications such as fitting to pictures etc. Very accurate, runs for approx. 1 year on one AA battery.



X 1010 **$18.50**



Portable Multimeter With Bench Stand

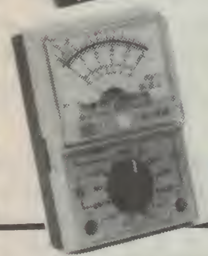
Includes Continuity Buzzer

20,000 Ohms/Volt DC • 8,000 Ohms/Volts AC, Mirror backed scale • Overload protected, 10 amp DC current range. Unique carry handle doubles as a bench stand.

Includes Battery Tester

Free Carry Case This Month Normally $4.95

Q 1080 **$39.95**



Economy Pocket Tester

High 2000 Ohms/Volt sensitivity • Overload protected • Dimensions 90 x 60 x 30mm • Mirror back scale helps prevent parallex error • Complete with test leads and instructions • Uses 1 x AA Battery.

Free Carry Case This Month Normally $4.95

Q 1013 **$19.50**

New Model IRD Has Fantastic Range

Infra Red Movement Detector

With Two Mode Lens

Why Pay $150 or More

This Month $79.00

Features: • Lens simply 'snaps' to either **wide angle** (range 40 ft.) for normal use or **Normal angle** (range 80 ft. plus) for corridor applictions. • Snazzy integral mounting brackets allows corner 90 deg. mounting as well as normal surface mount. (This is a fantastic feature as these work best in corners & are visually unobtrusive) • 12V DC Powered • Built-in test lamp • Alarm output SPDT 30V 1a.

S 5301

N.B. These professional detectors use state of the art circuitry to achieve ultra reliability in operation. They are currently specified by several "Name" commercial Security Companies.

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VLSI chip technology:

Meet the VL16C452, a bunch of megacells

Normally you'd expect development of a VLSI chip which provides a complete input/output subsystem for a computer to have taken many person years. But VLSI Technology's new VL16C452 'superchip' took a much shorter time, because it's simply a collection of proven *megacell* design modules...

by JIM ROWE

The new VL16C452 is a VLSI chip in more ways than one. As well as being an example of state-of-the-art *very large scale integration*, it also happens to be designed and made by VLSI Technology – one of the leading US firms in the area of VLSI application-specific or dedicated custom ICs, otherwise known as 'ASICs'.

Once upon a time, we thought an ordinary UART (universal asynchronous receiver/transmitter) chip was pretty complex, with its ability to send and receive serial data asynchronously at the same time, and interface synchronously with the parallel bus of a microprocessor system as well. Then when the manufacturers added software programming of the UART for setting its data format and baud rate, we thought the resulting ACE (asynchronous communications element) chips were 'just about as fur as they can go'. It seemed like we'd reached the ultimate in large-scale integration, with a complete functional subsystem on a chip.

But VTI's new VL16C452 actually combines the equivalent of TWO standard 8250-type ACE devices into a single chip – with a complete 8-bit parallel I/O interface circuit thrown in for good measure. It's quite a chip!

You'd think a whopping great ASIC like this would have taken quite a long time to develop, but apparently VTI whipped it up in next to no time. VTI's engineers can do little tricks like this because they've developed a technique of building them up from functional design building blocks known as *megacells*.

To understand what megacells are about, let's recap a bit. The more complex an IC, the longer tends to be its design and debugging time – unless special techniques are used. One approach often used in order to save time in producing ASICs is to use a 'multipurpose' chip design, with an array of many thousands of logic gates. These are then wired up via different metallisation patterns on the surface of the chip, to produce the desired custom circuit.

This approach certainly gives a somewhat shorter development time, but is relatively inefficient in that many of the gates in the chip array may not even be used. Chip sizes thus tend to be rather larger than if the chip were designed from 'scratch'. It's performance may also be compromised because of unavoidably long and circuitous gate interconnections.

Another established approach is to use standard cells – small sections of IC masking pattern that correspond to groups of gates, registers, arithmetic/logic elements, RAM and ROM modules, output drivers and so on. These standard cell designs can be tested and proven, and then kept in a CAD system 'library' as design modules. A new ASIC chip design can then be put together relatively quickly, by assembling it from these standard cell design modules.

This approach tends to produce rather smaller and more efficient chips than the gate-array approach, with better performance as well. However the development time can also be rather longer, especially where very large and complex chips are concerned.

To overcome this disadvantage, VTI engineers took the concept of standard cells further. Or if you like, they made the standard cells considerably bigger. Instead of consisting of just small logic modules, VTI developed cells corresponding to entire functional subsystems: a 64K block of ROM, a complete CRT controller, a DMA controller, an entire microprocessor and so on. All fully debugged and proven system modules, ready to be combined to make whatever custom VLSI chips may be needed.

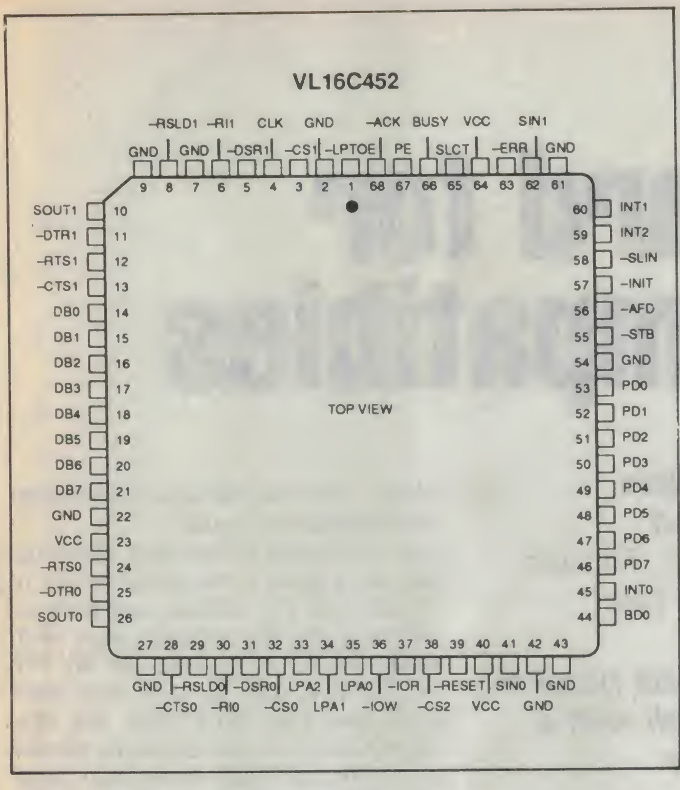
By the way, these megacells are not physical entities, like little chips that are glued together to make the final big chip. They're sets of mask pattern designs, stored in a chip CAD system library just like ordinary standard cells. The chip design can call them up at will, and slot them together to make up the overall design of the new custom chip.

To make the megacell concept practical, VTI engineers had to work out a way to interface electrically between megacell modules, so they'd link together. They did this by designing a special *internal* data communications bus, the VTIbus, for communications between cells within the overall VLSI chip.

The VTIbus is a special high speed synchronous bus, designed to be fully 'transparent' from outside the chip, and to allow full compatibility with virtually any external microprocessor bus.

As well as developing the VTIbus, the engineers also had to make their megacells physically compatible, so they would go together in a modular fashion with convenient layout for the internal VTIbus interconnections. They ended up with all megacells a standard 73 mils high (1.85mm), apart from the 1K byte static RAM megacell, which is double this figure. Needless to say the cells have variable widths, according to their complexity.

Typically the address lines, Vss supply



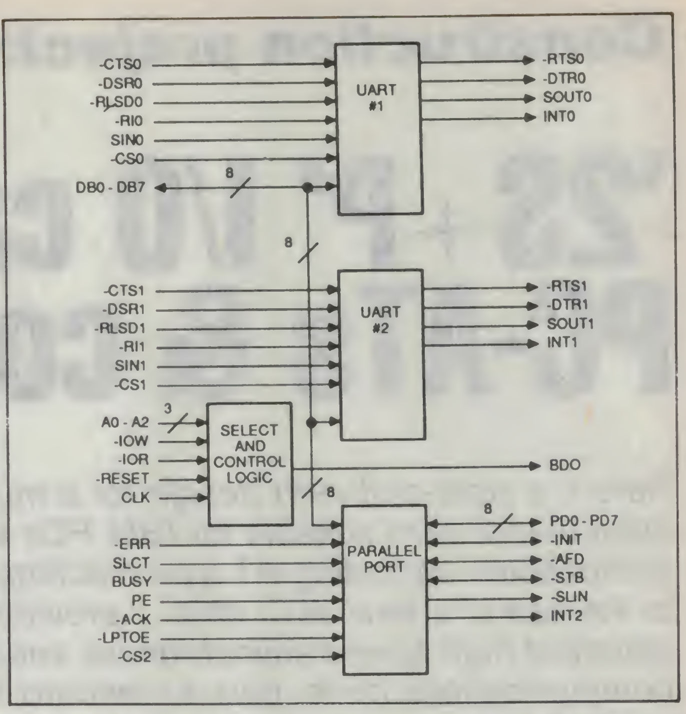


Fig.1 (above): The VL16C452 includes two full ACEs and a parallel port. Fig.2 (left): Its pin connections.

line and some I/O and control signal lines run along one side of the megacells, while the data lines, Vdd supply line and remaining I/O lines run along the other.

Table 1 shows a list of the current VTI library of megacells, available for design of ASIC chips along with a very large library of smaller standard cells.

To further speed up design of VLSI chips, VTI has developed quite a range of software design tools. These have names such as *Design Assistant* and *Chip Compiler*, and they're designed to take over a lot of the hack work associated with the design of large chips. They also allow the final chip layout to be optimised, for highest performance and smallest size.

Just as a software compiler is designed to assemble modules of machine-language program, in response to high-level commands, a chip compiler is designed to assemble standard cell and megacell modules – also in response to high-level commands.

Using its megacells and software design tools, VTI engineers claim to have made significant reductions in not only the design time for new VLSI ASIC chips, but their physical size as well. For example they quote a new 16-bit RISC computer chip they've produced as having a chip size only 40% that of a comparable gate-array implementation. Apparently an implementation using conventional standard cells took somewhat longer, and ended up with a chip still 70% the size of the gate-array version.

Using the same techniques, VTI has also been able to produce a *single chip* version of all of the main functions performed on a PC-compatible motherboard. A custom chip produced for one of its customers, who can't be named, the chip combines the equivalent of an 82C84 clock generator, an 82C59 interrupt controller, an 8253 timer, an 82C55 O/O port, an 82C37A DMA controller, and 82C88 bus controller plus memory logic, glue logic, DMA registor and latch logic, and bus isolation and control logic!

That's the basic idea of VTI's megacell system, and its combination with software design tools. Now let's look a little more closely at the new VL16C452 multi-I/O port chip.

As you can see from Fig.1, the VL16C452 consists of two complete software-programmable UART or 'ACE' elements, plus a complete parallel port and selection and control logic. The two serial ports are implemented from VTI's VMC82C50A megacells, which are functionally equivalent to the industry-standard 8250A and 16450 ACE devices. They each provide all functions for a complete serial asynchronous communications port, with programmable baud rates from 50 to 56,000bps, and provision for all normal RS232C handshaking signals.

The VMC82C50A megacells used in the chip each measure 73×87 mils, and have a 200ns cycle time. The parallel port has similar performance, making the overall chip compatible with PC/AT level computers.

The VL16C452 comes in one of the newer 68-pad plastic leadless chip carrier (PLCC) packages. For those that aren't yet familiar with this type of

Continued on page 90

ID code	Description
VMC68C45	CRT controller (4.5MHz video, 3MHz proc, I/F)
VMC82C37	Programmable DMA controller (4 channels, 1.6 Mbps)
VMC82C50	Series asynchronous comms element
VMC82C54	Programmable interval timer/counter
VMC82C55	Programmable peripheral interface (24 bit)
VMC82C59	Programmable interrupt controller
VMC82C84	Clock generator/driver (25MHz)
VMC82C88	Bus controller for 80C86, 8086/88
VMC00C01	Static RAM modules (256x8 or 1Kx8, 75ns)
VMC00C02	ROM modules (1Kx8 or 2Kx8, 60ns, buffered)

TABLE 1: Current VTI megacells

Construction project:

'2S+P' I/O card for PC-ATs & compatibles

Here's a state-of-the-art design for a multiple input/output card suitable for IBM PCs and compatibles (including AT type machines). Thanks to the use of a new VLSI chip, it provides two standard high speed asynchronous serial communications ports, plus a standard 8-bit parallel port for printers and similar peripherals - all with a handful of parts on a very short and easily assembled PC board.

by JIM ROWE

For many non-electronics users of personal computers, a single printer port and perhaps a single serial communications port are all they're likely to need. These will let them hook up a printer and a modem, or perhaps a mouse. But for PC owners and users with a more technical bent, like many *EA* readers, there's often a need for rather more I/O (input/output) ports than this very basic configuration.

If you're using your PC for computer-aided design or drafting, for example, you may well need at least two serial ports – for a mouse as well as a modem, or perhaps a plotter with a serial interface.

A situation even more likely to need extra ports is where you're using your PC to control other equipment. Here you might easily need a couple of additional serial ports, and perhaps an extra parallel printer port or two. It's then that you start looking around in earnest for an extra I/O card or two.

If you have an IBM PC, PC/XT or one of the many compatibles, there's no great problem. Plug-in I/O cards are fairly readily available, and some of them are quite reasonably priced.

But if you have a PC-AT or AT compatible, things are a little trickier. Like many of the other low cost PC cards around, quite a few of the el-cheapo I/O cards aren't really compatible with AT machines. Many of them simply aren't fast enough, and trip up the AT's processor and software. All I/O cards ain't *AT* I/O cards!

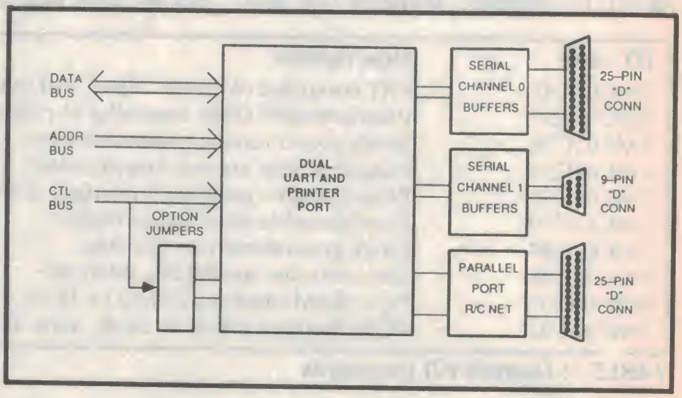
The I/O card design described here is fully compatible with AT type machine timing, so it solves that particular problem. It provides two fully buffered, independently programmable PC-type serial asynchronous communications ports, each capable of operating at 18 different data rates: from 50 to 56,000 bits per second. Both ports implement all normal modem control signals.

In addition, it provides a standard 8-bit parallel port, suitable for driving any normal Centronics-type printer or plotter, and with the usual complement of 'handshaking' signals.

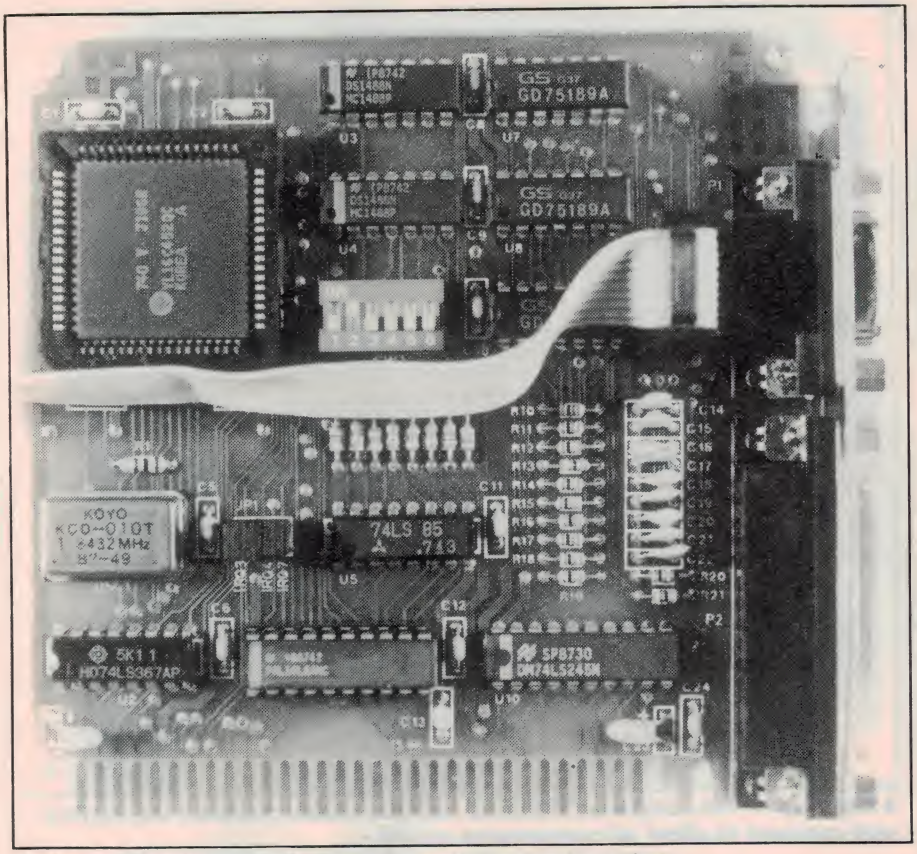
A DIP switch on the card allows the two serial ports to be placed at any of 16 different I/O address combinations, including the two addresses most often used (3F8-3FF or COM1:, and 2F8-2FF or COM2:), and the two next most often used (3E8-3EF/COM3: and 2E8-2EF/COM4:). It also allows the parallel port to be set to any of the three standard addresses recognised by DOS (LPT1:, LPT2: and LPT3:). So there's lots of flexibility, for those who really *do* need multiple I/O cards and plenty of ports.

Jumpers on the card also allow disabling of the hardware interrupt lines from the three ports back to the processor, to cope with situations where there are additional ports on other cards, and there are interrupt conflicts. IRQ4 is normally used for serial port #1, IRQ3 for serial port #2 and IRQ7 for the printer port (when it is the sole, or primary printer port).

All of these functions are squeezed into a short-short slot PC card, only 116mm long including the external connectors. The parallel printer port DB-25 connector (female) and a DB-9 connector (male) for one of the serial ports are mounted directly on the rear of the card



A simplified block diagram for the I/O card, showing the key role played by the VL16C452 chip.



A view of the completed I/O card, ready to plug in and go.

itself, on the usual mounting bracket. The second serial port is accessible via a 10-pin dual row header, just to the front of the DB-9 connector. This mates with an insulation-displacement connector (IDC), linked via a short ribbon cable to a DB-25 male connector (male) on a second mounting bracket.

So you end up with one serial port via a DB-9, and the other via a DB-25. This shouldn't be a problem, since both are now accepted standards for PC serial ports, and cables are readily available for either (as are adaptors).

Thanks to the use of the latest chip technology, the card is literally only a handful of parts on a card. This makes it is very easy to put together. It should also be quite cheap – you should be able to build it for around 60% of the cost of one of the cheaper commerical cards. But this way, you get a card that you *know* is going to run properly in an AT machine!

You also have the fun of building it yourself, and getting some experience with the very latest technology.

By the way, the complete design for this I/O card originates from US chip maker VLSI Technology, which is represented in Australia by Energy Control International of Sumner Park, in Queensland.

Circuit details

Just about all of the new I/O card's main functions are performed by a single new gee-whiz VLSI chip, the VL16C452. This combines the equivalent of two standard 8250A-type ACE devices into a single chip, with a complete parallel I/O port interface circuit thrown in for good measure. It's quite a chip!

You'll find further details about the VL16C452 and the megacell technology that made it possible in the preceding article.

As you can see from the block diagram in Fig.1, the VL16C452 (U1) really does provide most of the functions. The main support circuitry needed is for buffering of the various port signals themselves, and also between the VL16C452 and the main PC bus lines.

As shown on the main circuit, buffering for the two serial ports is provided in fairly conventional fashion by 1488-type line drivers (U3,U4) and 1489-type line receivers (U7,U8,U9). Buffering for the parallel port signals is performed by simple R-C filtering, using 22-ohm resistors and 2nF capacitors.

Buffering between the VL16C452 and the main PC data buslines is performed by U10, a 74LS245 bidirectional octal buffer. Buffering of the three lowest-order address lines (SA0-2, the only ones needed by the VL16C452 itself) is performed by U2, a 74LS367 hex buffer.

The remaining system I/O address lines SA3-9 are fed directly to U6, a 16L8 'PAL' or *programmable array logic* device. This is pre-programmed as a custom address decoder, accepting the address line signals, the address enable signal AEN and the reset drive signal RESET DRV and derives the three chip-select signals CS0-2 used to control the VL16C452. It also produces the chip's RESET signal, and the DOE enable signal for the data bus buffer U10.

U5, a 74LS85 4-bit comparator, is used to compare the settings of poles 3-6 of DIL switch SW1 with the address lines SA4-7, to provide a 'serial ports enable' signal for the PAL. This allows the serial ports to be mapped into any of 16 different pairs of locations in the 308-3FF/208-2FF region of I/O space (see Table 1).

Poles 1 and 2 of SW1 are used to feed logic signals to pins 14 and 15 of the PAL, to map the printer port to any of the three addresses 3BC-3BF, 378-37F or 278-27F, corresponding to DOS printer port assignments LPT1:, LPT2: and LPT3: (Table 2).

The programmable baud rate dividers in the VL16C452 need a master clock input signal of 1.8432MHz, and this is provided by an integrated crystal oscillator.

The three jumpers in block JP1 are used to disable the hardware interrupt request signals IRQ3, IRQ4 and IRQ7 if required. The first two of these correspond to the serial ports, which DOS will normally identify as COM2: (or COM4:) and COM1: (or COM3:) respectively, while IRQ7 corresponds to the printer port (Table 3).

Normally all three jumpers should be left in, to enable the interrupts from the three ports. The only situations when one or more of the links may need to be removed are where other cards in the system provide ports using IRQ3,4 or 7, and a conflict arises.

Wiring it up

Wiring up the card should be quite straightforward, as Energy Control International is supplying complete kits. The kit will include the pre-programmed 16L8 PAL device as well as the VL16C452 PLCC chip, clock oscillator and all minor parts. Note that the PCB pattern for the card is copyright by VLSI Technology, and the boards are only available as part of the kit.

I/O card

As shown in the photos, the PCB supplied as part of the kit is silk screened with a very detailed parts location pattern, showing exactly where everything goes. It even shows IC orientation, so there shouldn't be any hassles.

Needless to say you'll need a low-power soldering iron with a fine-pointed bit, to make the joints on the board without producing solder bridges or causing component damage.

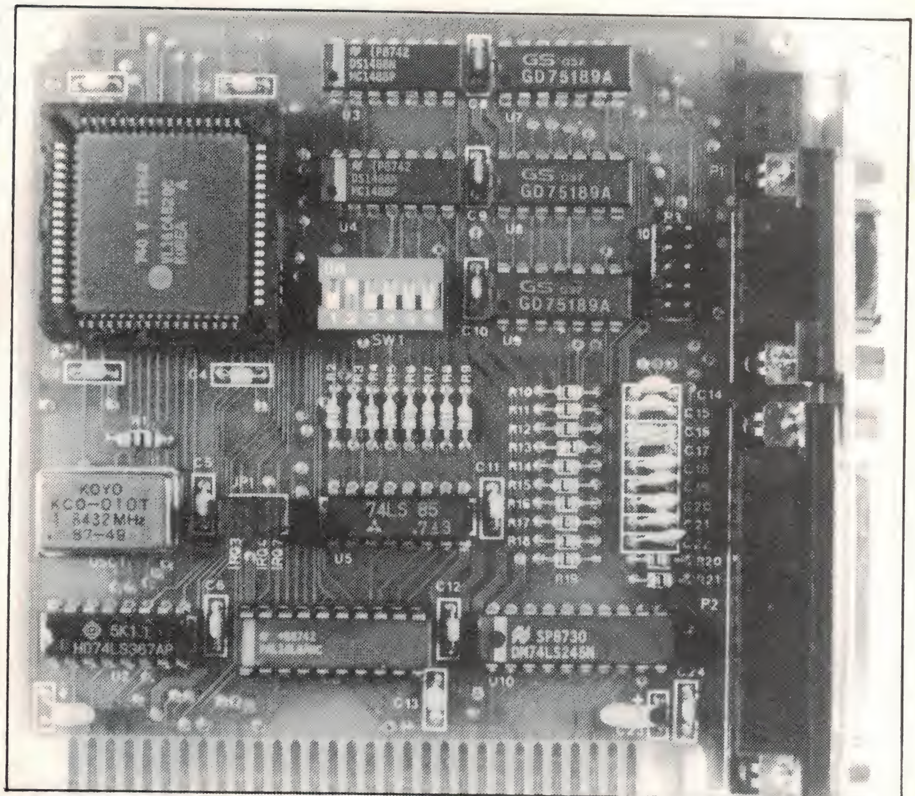
I suggest you fit the passive components (resistors and capacitors) first, then the pin blocks for jumper group JP1 and P3, the off-board serial port connector. You can also solder in the DIL switch SW1, and the sockets for the PLCC chip and the other socketed ICs. Make sure you mount the PLCC socket with its 'chamfered' corner orientated towards the lower left, looking at the PCB on the component side and with the edge connector at the bottom. The silk-screened pattern shows this also.

Then screw the right-angle PCB mounting DB connectors P1 and P2 loosely to the rear angle bracket, making sure that you've fitted the little pressed-metal nuts behind the connectors with their solder tails poking *downwards*, through the connector mounting holes. Before tightening up the screws, offer up the connectors to the PCB, fitting all of the connector pins through the PCB holes without bending any.

Then, holding the connectors tightly against the PCB, tighten the connector/bracket mounting screws and then solder the connector mounting tails into their holes. These will then hold everything together, while you solder all of the remaining connector pins.

At this stage you can carefully solder in the ICs that are directly fitted to the PCB, and the crystal oscillator OSC1. Note that the case of this part has a small ink dot on the top near one corner, which is also not rounded like the other three. Orientate the oscillator so that this corner is towards the lower left, again looking at the component side of the PCB with the edge connector at the bottom. Again there's a small dot on the silk screened pattern, to guide you.

The final step is to plug the socketed ICs into their sockets carefully. Pay particular attention to the VL16C452 PLCC chip U1, of course – it's the most expensive part on the whole board! Identify its chamfered corner, and orientate it with this corner matching the chamfered corner of the socket. Note that the edge of the device next around from the chamfered corner,



A close-up of the completed I/O card, with the ribbon cable for the second port removed to show all components clearly.

COM port address	Pole 3	Pole 4	Pole 5	Pole 6
308-30F/308-20F	ON	ON	ON	ON
318-31F/218-21F	OFF	ON	ON	ON
328-32F/228-22F	ON	OFF	ON	ON
338-33F/238-23F	OFF	OFF	ON	ON
348-34F/248-24F	ON	ON	OFF	ON
358-35F/258-25F	OFF	ON	OFF	ON
368-36F/268-26F	ON	OFF	OFF	ON
378-37F/278-27F	OFF	OFF	OFF	ON
388-38F-288-28F	ON	ON	ON	OFF
398-39F/298-29F	OFF	ON	ON	OFF
3A8-3AF/2A8-2AF	ON	OFF	ON	OFF
3B8-3BF/2B8-2BF	OFF	OFF	ON	OFF
3C8-3CF/2C8-2CF	ON	ON	OFF	OFF
3D8-3DF/2D8-2DF	OFF	ON	OFF	OFF
3E8-3EF/2E8-2EF	ON	OFF	OFF	OFF*
3F8-3FF/2F8-2FF	OFF	OFF	OFF	OFF†

** Normal setting for COM1: and COM2:*
† Setting for COM3: and COM4:
Note 1: other address settings may conflict with video graphics controller cards, and should not be used when these cards are fitted to the system.
Note 2: the serial port using the card's on-board DB-9 connector has the 3X8-3XF addresses, while that using the 10-pin header has the 2X8-2XF addresses.

TABLE 1: Serial port address selection.

Printer port selected	Pole 1	Pole 2
LPT1:	ON	ON or OFF
LPT2:	OFF	ON
LPT3:	OFF	OFF

TABLE 2: Printer port address selection

Jumper	Function
IRQ4	Enable interrupts from serial port #1 (#3)
IRQ3	Enable interrupts from serial port # (#)
IRQ7	Enable interrupts from parallel printer port

Note: all jumpers should normally be fitted. Remove only if required to disable individual interrupt lines, to prevent conflicts with other I/O ports in system.

TABLE 3: Hardware interrupt jumpers

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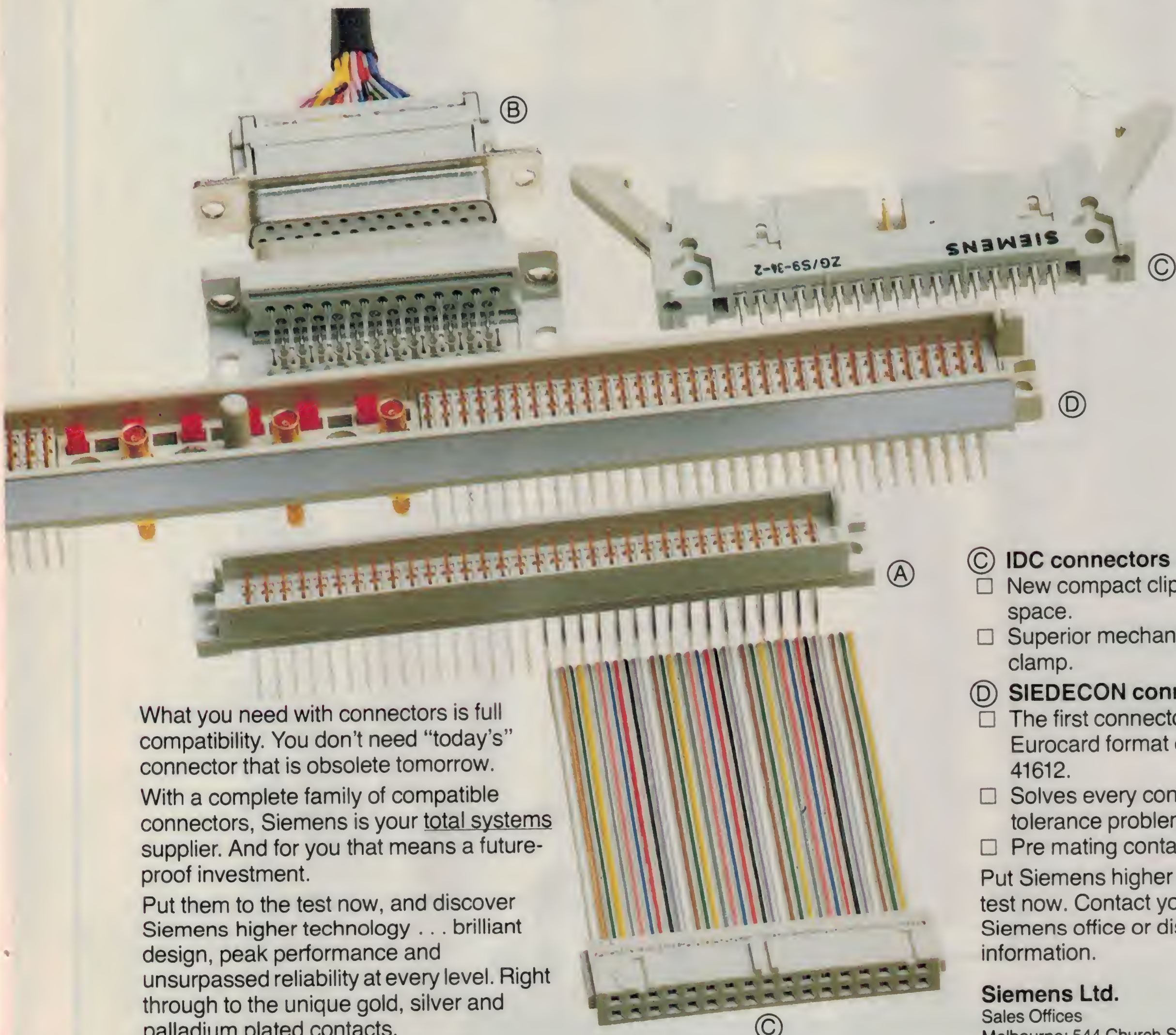

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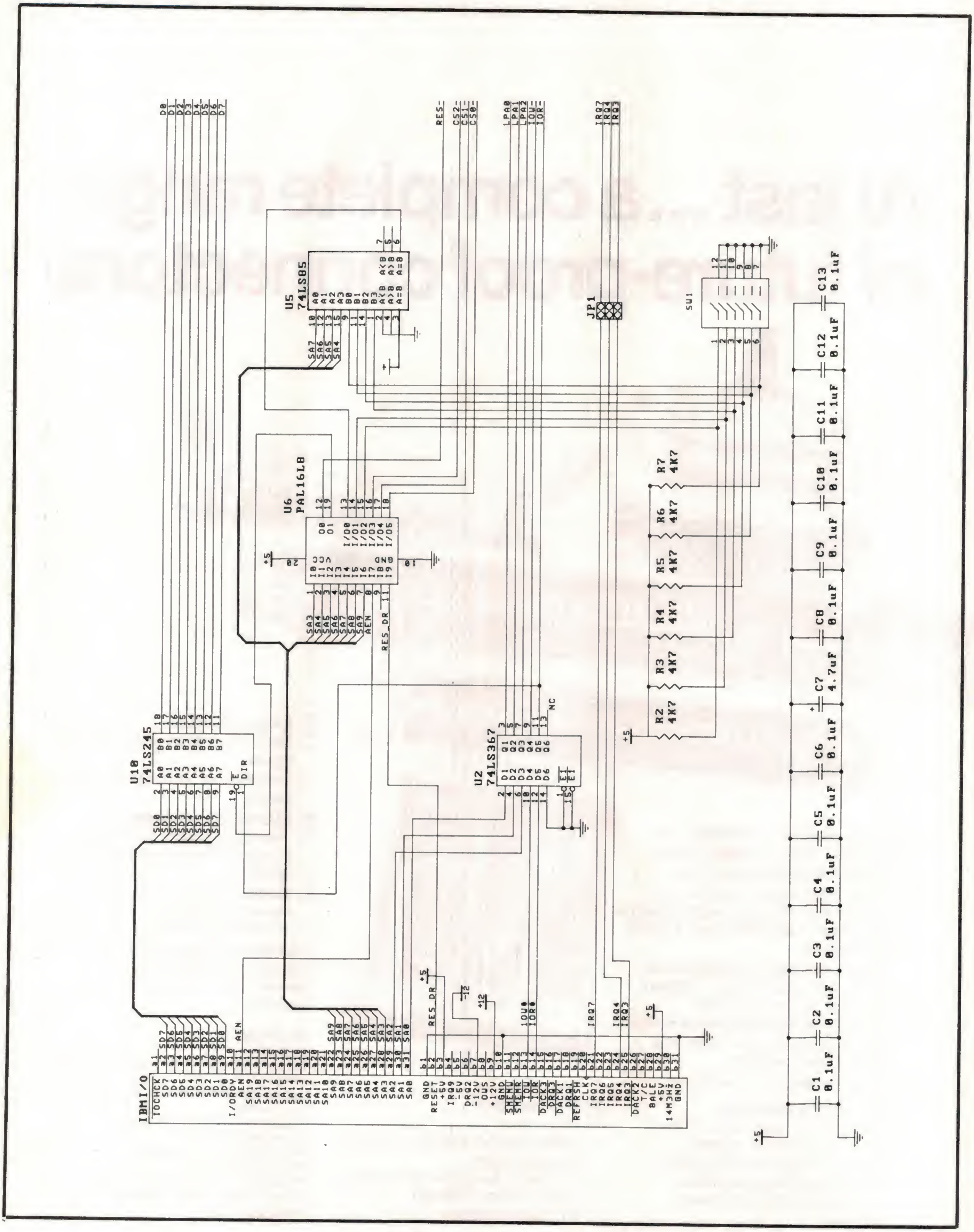
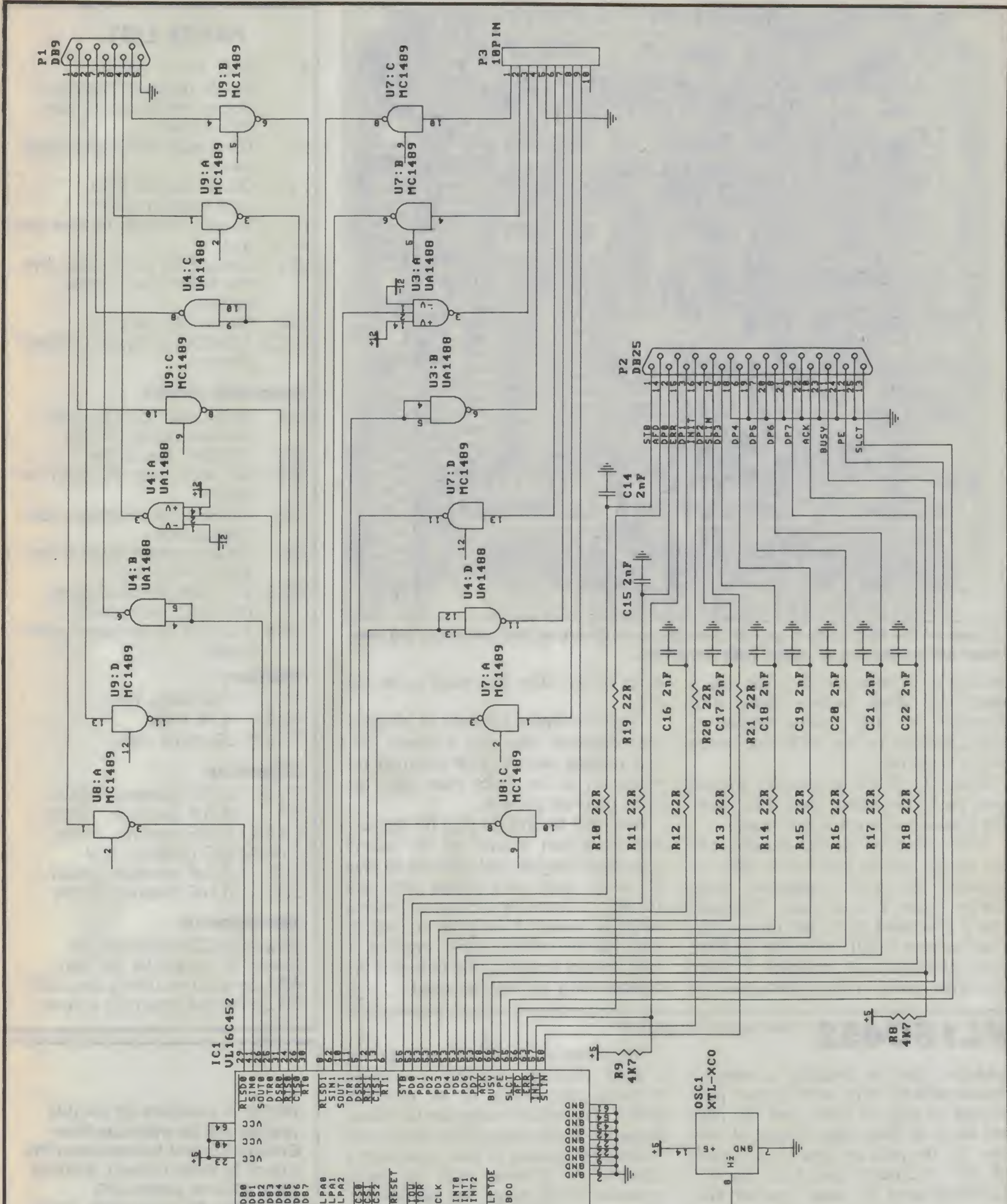
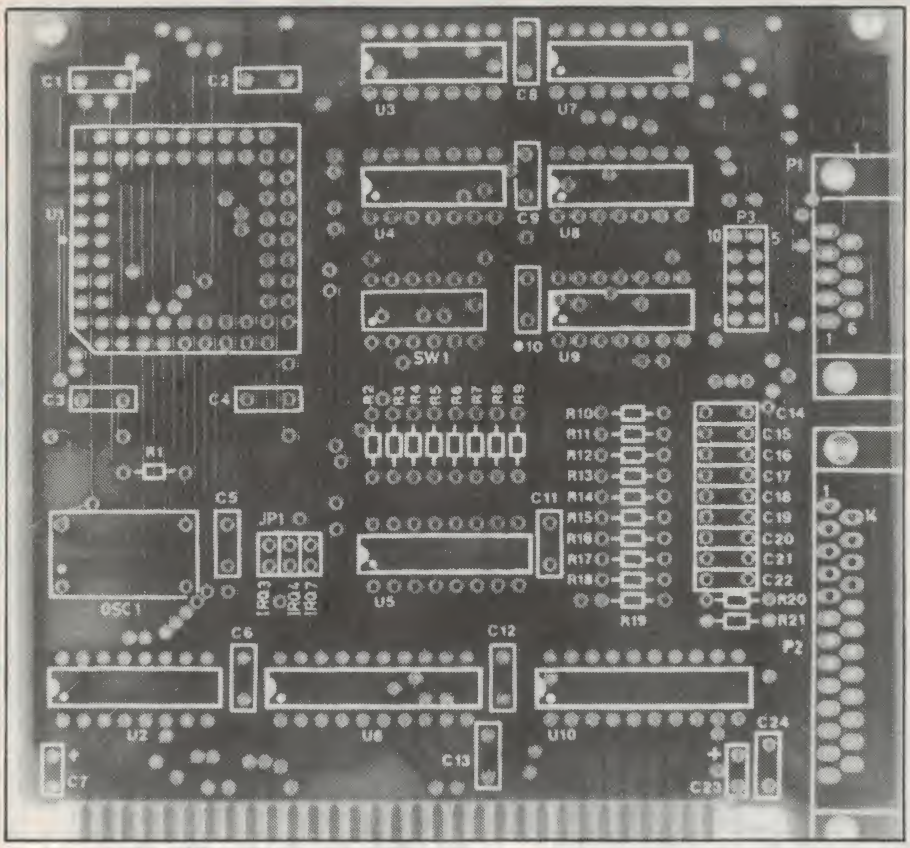
I/O card



IBMI/O
U10
74LS245
U6
PAL16L8
U5
74LS85
U2
74LS367
JP1
SW1
R2 4K7
R3 4K7
R4 4K7
R5 4K7
R6 4K7
R7 4K7
C1 0.1uF
C2 0.1uF
C3 0.1uF
C4 0.1uF
C5 0.1uF
C6 0.1uF
C7 4.7uF
C8 0.1uF
C9 0.1uF
C10 0.1uF
C11 0.1uF
C12 0.1uF
C13 0.1uF



The circuit schematic for the I/O card has been split into two sections for clarity. The buffering and PAL address decoding section is opposite left, the main chip and port buffering above.



A view of the PCB before any of the components are added, showing the very clear silk-screening to assist with assembly.

moving in a clockwise direction, has a small 'pit' about halfway along. This identifies the chip's connector pad 1, also identified on the PCB silk screen with a small dot.

When the PLCC is correctly located over the socket, gently push it in, exerting pressure evenly to keep it level.

That's about it. All that remains is to set up the various switches of SW1, as required for your computer, using Tables 1 and 2 as a guide. Normally you'll also need to fit the three interrupt jumpers to JP1, to enable all three port interrupt lines, although if there are other ports in the system, one or more of the links may need to be left out.

Then it's simply a matter of plugging the completed card into a vacant slot, and running your SETUP program (or whatever) to let DOS know that the extra ports are present.

Note that the DB-25 plug for the second serial port mounts on the second rear-panel bracket, and connects to plug P3 on the card via a ribbon cable and ID socket. Normally the second bracket would be mounted alongside the card itself, but the ribbon cable supplied is long enough to run a little further if the adjacent slots are both occupied.

PARTS LIST

1	PCB, 110 x 108mm
1	DB-25 plug with moulded ribbon cable and 10-way IDC socket
P1	DB-9 plug, PCB right-angle mount
P2	DB-25 socket, PCB right-angle mount
P3	10-way PCB pin header, two row
JP1	6-way PCB pin header, two row (with three jumper sockets
SW1	6-pole DIL switch
OSC1	1.8432MHz crystal oscillator module

Integrated circuits

U1	VL16C452 serial/parallel interface ASIC (PLCC)
U2	74LS367 hex buffer
U3/4	MC1488 quad RS-232C line driver
U5	74LS85 four-bit magnitude comparator
U6	16L8 programmable array logic (PAL) chip
U7-9	MC1489/GD75189 quad RS-232C line receiver
U10	74LS245 bidirectional octal buffer

Resistors

R1	100 ohms 1/4W
R2-9	4.7k 1/4W
R10-21	22 ohms 1/4W

Capacitors

C1-6	0.1uF ceramic, 50VW
C7	4.7uF tantalum, 16VW
C8-13	0.1uF ceramic, 50VW
C14-22	2nF ceramic, 50V
C23	4.7uF tantalum, 16VW
C24	0.1uF ceramic, 50VW

Miscellaneous

68-way PLCC socket for U1; 20-way IC socket for U6; two PC-type card mounting brackets; DB connector mounting screws.

VL16C452

Continued from page 83

package, they're basically a compact square package with small contact pads instead of pins or leads, and the pads are along all four edges instead of only two. As the pads are spaced on a pitch of .05" (1.27mm) instead of the 0.1" (2.54mm) used for most familiar DIL packages, this allows many more connections for a given package size.

For example the 68-pad PLCC package used for the VL16C452 measures only 25mm square – about 1/3 the size of a conventional 64-pin DIL package (see Fig.2).

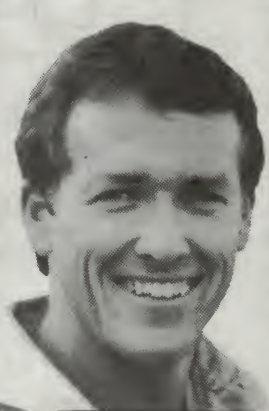
One corner of the PLCC package has a small chamfer, and this is used to orientate the device in its matching socket. The socket transposes the closely-spaced device connections out to two "concentric" squares of pins, spaced on a standard 0.1"/2.54mm pitch for more convenient PCB design and assembly.

Starting on page 84 you'll find the design for a new I/O card for PC-AT compatibles, using the new VL16C452 chip. It illustrates very well how VLSI chips like this can be used to achieve dramatic simplification of familiar system modules.

NOTE: A complete kit for this project will be available from Energy Control International Pty Ltd of 26 Boron Street, Sumner Park 4074 or phone (07) 376 2955. The cost of the kit is $99.00 plus $20.00 sales tax, plus $6.50 for packing and postage anywhere in Australia.

This man isn't a computer expert,

yet he chose a UNI-X CompuPak kit - and assembled it in one night!



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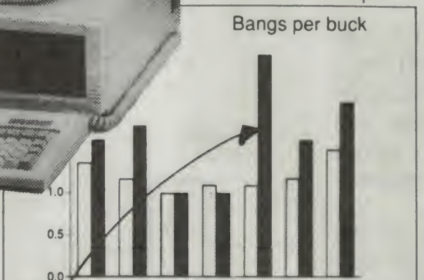

Bangs per buck — just one way of comparing the relative merits of these seven ultra-cheap clones. The lighter shading denotes price (in thousands of dollars) and the darker shading a performance index. See Table 3 for more details. (Machines in order from left to right are ... Bod Irving, MicroDOS, Commodore, Uni-x, Atronics and Techn...

Processor.

NEC. The Uni-x contains a NEC V20, manufactured by Sony.

... Thus a V20 running at 4.77MHz will outrun an 8088 running at the same clock speed. ... machines examined provided a standard PC clock rate of 4.77MHz as a minimum, although the Uni-x delivered higher than standard performance even on this clock rate by virtue of the V20. The Atlantis and ... machines ...

Performance.

... The Uni-x is fastest overall, providing a 50 per cent boost over the Technology Interface due to the V20.

Display.

... delivered with a nice INTRA tilt/swivel amber screen. ...

Cost Effectiveness.

As you might expect, the do-it-yourself Uni-x comes up trumps with its low cost and relatively high performance. ...

Specifics.

very sens... place ...
The Uni-x features a delightfully small motherboard. It has employed a VLSI component to replace the Intel 8253 timer, 8255 PPI, 8237 DMA controller and several other components. This reduced the component count and a simplified motherboard serves to reduce costs.

. . . see for yourself in the full Report in the October '87 issue, or ring us for a copy.

No, he's not a genius, but he's brilliant at spotting great value. Like many of us, he's realized that a personal computer is invaluable, yet the price tag for a professional unit has always been a little beyond his reach. Until now.

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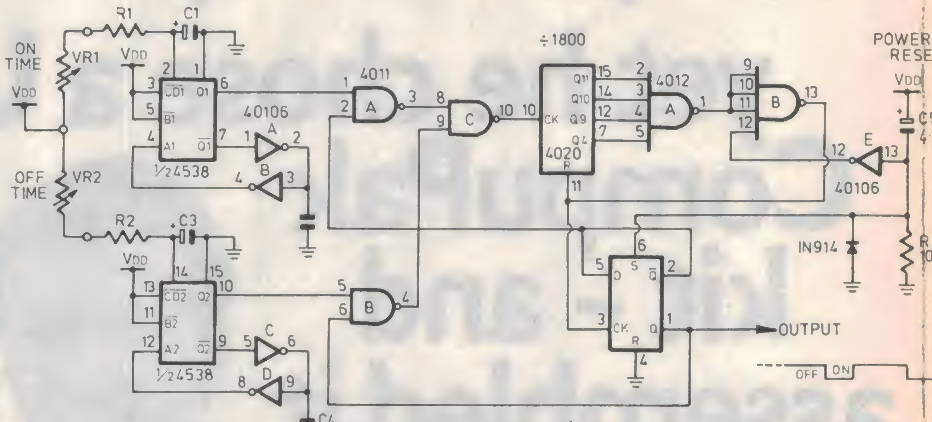
Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.

Linear scale on/off timer



This timer circuit gives independently variable on/off times. But its main interest is that using the characteristics of the 4538 monostable, and wiring it as an oscillator, the on/off times are close to a linear function of the (linear taper) variable resistors VR1 and VR2, for a range of V_{DD}'s.

The period of oscillation for the on time is approximately T = (VR1+R1)C1. The discrepancy is the delay through the 40106 and 4538, about 800ns with common CMOS. Thus, the maximum frequency of oscillation in the 4538 allowing close to linear frequency/resistance, is about 120kHz.

The delay of the 40106 is needed to ensure reliable oscillation of the 4538. C1 and C3 should be as small as possible, as the discharge circuit inside the 4538 is not a short circuit, and the discharge time may become significant for large capacitance.

The rest of the circuit is a divide-by-1800 counter and toggle for the two oscillators, and a power-up reset. The divide-by-1800 is used to give a 30-minute on/off time for a 1Hz 4538 frequency, and to average out phase differences between the two oscillators.

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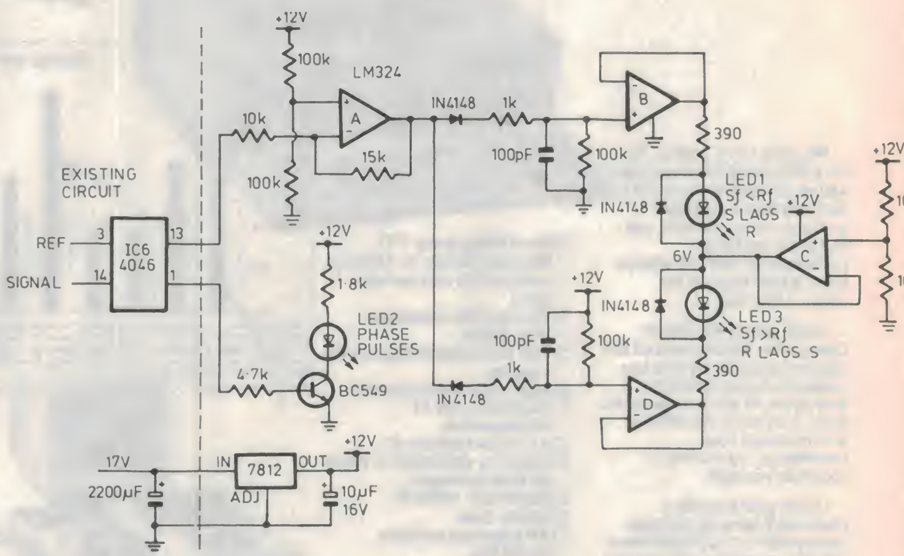
$30

Display for Phase Difference Meter



The Phase Difference Meter (EA July 1987) calls for the use of a dual trace CRO to establish the phase relationship between the reference frequency and the frequency of the signal. The circuit shown here provides the same information, using 3 LEDs.

There are two unused outputs on the 4046 (IC6), derived from an edge triggered phase comparator. Pin 13 (comparator output) is high most of the time when the signal frequency is higher than the reference frequency, and high corresponding to the phase difference when signal and reference have the same frequency but reference lags signal. The output, being tri-state, is open circuit the rest of the time. The output is low most of the time when the signal frequency is lower than the reference frequency, and low corresponding to the phase difference when signal and reference have the same frequency but signal lags reference. Pin 1 (phase pulses) is high when pin 13 is open circuit.

The 12 volt regulator (7812) of this circuit connects to the filter capacitor (2200uF) and supplies power to the circuit. LED 2 is driven via a transistor buffer from pin 1. ICa (LM324) is an inverting amplifier with a gain of —1.5 which is biased at half rail. Its output is either at 12 volts, 6 volts or ground.

The diodes at the output steer a positive pulse to ICb and a negative pulse to ICd. The 100pF capacitors discharge only through the 100k resistors, so that even very short pulses are displayed. ICb and ICd buffer these pulses and drive LEDs 1 and 3. Diodes across the LEDs protect them from being reverse biased. ICc is a voltage follower supplying 6 volts. The notations indicate conditions when the LEDs will be illuminated.

Peter M. van Schaik,
Gilgai, NSW.

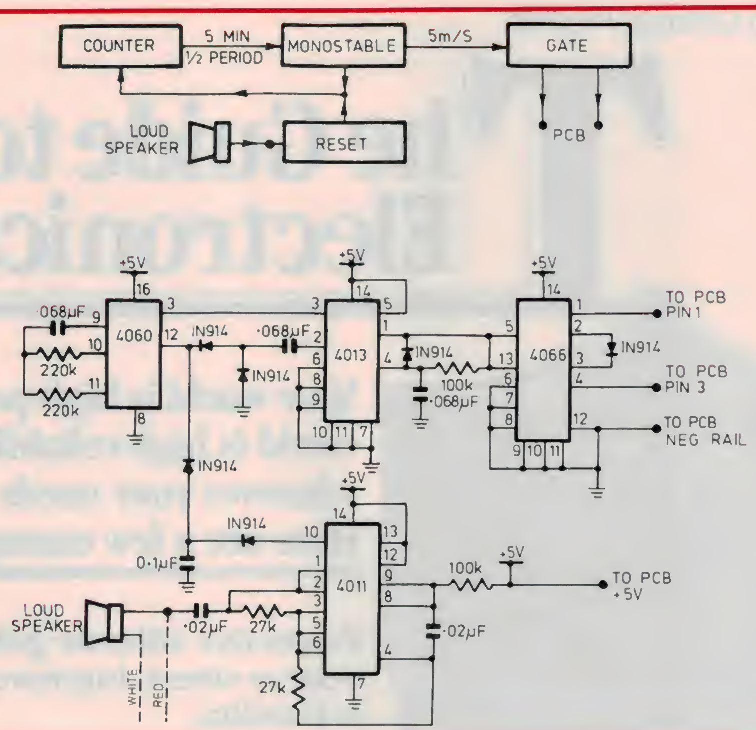
$30

'Keep awake' for Concertmate 500

After reading about the Realistic Concertmate series of electronic keyboards in the January issue of EA, I bought a Model 500, thinking to use it to provide accompaniments for amateur music making. But what made it useless for that application was the inbuilt shutdown feature which caused loss of program after 7 minutes of nonplay. It was most frustrating to lose up to an hour of work while pausing for a cuppa.

After a check around the circuitry I concluded that the shutdown feature was integral to the VLSI and was therefore unlikely to be readily defeated. However, as it was reset by the playing of any one note within the time limit, an add-on circuit was devised to do just that.

In the Concertmate 500 the keyboard drives a diode matrix which is connected to the main PCB via a flat 12 connector strip, soldered to tags. If a diode is connected across pins 1 and 3 of these tags for a minimum of 5 milliseconds, the VLSI will play low F in whatever tone has been selected. The add-on circuit plays this note every 5 minutes but to avoid hearing or recording it while using the keyboard, the signal from the loudspeaker is used to suppress it.



A diode permanently wired across the PowerPac socket on the PCB will allow the internal batteries to act as a 'no break' supply, should the external supply fail for any reason.

Continued on page 130

Special Feature:

PCB Technology

Each year at about this time, 'Electronics Australia' takes a look at printed circuit board technology. Here's a quick overview of the current state of the art, and a guide to the articles that follow.

What's happened in the PCB manufacturing industry over the last 12 months? Well, in a sense, nothing very spectacular – particularly in Australia. It's mainly been a period of consolidation, with designers and manufacturers building upon previous developments and fine tuning them to achieve improved production yields and/or meet more demanding quality control standards.

Australian PCB makers continue to build up their expertise in the area of multi-layer boards, as needed for production of complex computer and military equipment using VLSI circuits. There are now quite a few local companies with considerable experience with multilayer boards, including Teknis, Printronics and Morris Productions. In the last 12 months these firms have variously obtained, or are currently obtaining approval for supply of multi-layer boards to both local and overseas defence forces (such as the US military). Needless to say, this approval involves meeting rigid specifications for quality control.

The firms concerned are producing multi-layer boards with as many as 24 different layers – although few boards with more than 9 layers are used in Australian electronics equipment.

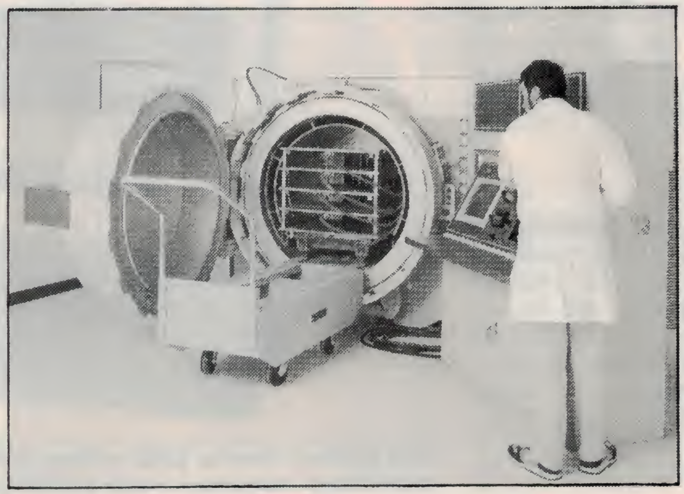
A recent development in local PCB manufacturing is the addition of equipment for *hot air solder levelling*. This is the technique of using a blast of hot air to remove excess solder from pre-soldered boards, to leave them with a uniform solder coating (even in through-plated holes). It's a messy process, but one that leaves the boards very clean and free from defects such as solder bridges or blocked holes.

Overseas, considerable work is being done on developing improved PCB drilling machines. The rapid advances of surface-mount technology (SMT) and VSLI circuits have brought with them the need to drill ever-increasing numbers of extremely small holes, at ever-faster production speeds to achieve productivity targets. Developing machines to achieve these goals is no mean feat, but firms such as Pluritec Italia SPA and Union Tool, in Europe and Dynamotion in the USA are meeting the challenge.

In the articles that follow, you'll find a very interesting discussion of recent developments in PCB drilling technology, by courtesy of Pluritec. There's also details of a new low cost automated PCB testing system, developed right here in Australia by Sydney firm Binary Engineering. You'll also find a discussion of the impact of surface-mount technology on PCB design using CAD, by courtesy of Melbourne CAD bureau RCS Design. And finally, there's information on a selection of new products specific to PCB production or testing.

We hope you'll find the feature of interest and value. Our thanks to International Precision Products, Binary Engineering, RCS Design, Morris Productions, Teknis, Printronics and the other companies which supplied information to help us produce it for you.

Hot air solder levelling (at rear) with pre- and post-treatment lines and automatic loaders and stackers, at Teknis in Hendon SA.



Teknis also boasts this advanced vacuum press technology, used in the manufacture of multilayer boards.

PCB Feature:

Advances in PCB drilling technology

Developments such as surface mount technology have created a need for printed circuit boards to have increasing numbers of smaller and smaller holes. Combined with the ever-present need to achieve higher productivity, this has demanded the development of a 'new breed' of precision PCB drilling machines.

by WOJCIECH KOSMOWSKI

The growth of surface-mounted PCB technology has presented the drilling equipment industry with a cluster of critical new machine-design problems, not unlike those the industry faced more than a decade ago with the soaring demand for high-speed, high-feed equipment for drilling double-sided circuit boards.

At that time, the industry responded first by modifying existing equipment for the new task, until the limits of the basic design were reached and then – reluctantly – facing up to the problem of tailoring a new machine architecture to meet the new demands.

Now, after exhausting the possibilities of adapting conventional drilling equipment to the special requirements of small-hole drilling, the industry is being forced to create a new machine architecture to meet the special problems of high-speed production drilling of holes in the .004" – .030" (0.1 – 0.7mm) diameter range.

The problems

There are two basic problems; the low productivity of current small-hole drilling equipment, and the excessive rate of drill-bit breakage due to machine instability. The scale of the primary problem – the dramatic decline in productivity encountered in shifting from conventional to small-hole drilling – can be stated in the following way. Existing equipment is designed to drill conventional boards in stacks 3 to 4 boards high, at average feed rates around 200" per minute. Boards requiring small-hole drilling cannot be stacked, but must be drilled one at a time – a 4/1 reduction. The overall loss of productivity is therefore on the order of 16/1, which places an intolerable restriction on rapidly growing small-hole production.

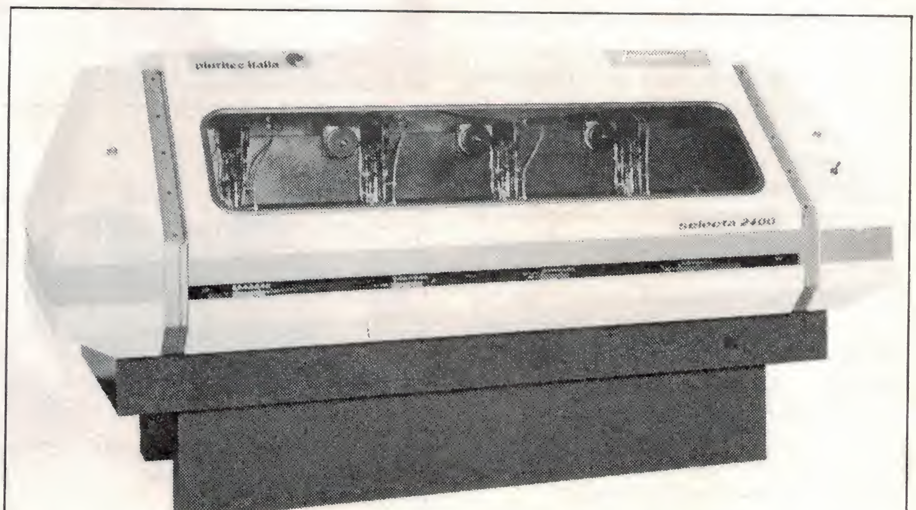
The primary problem is rooted in the second problem – the relative instability of even the smoothest conventional drilling machine, which regularly destroys small drills at feed rates above about 50" per minute. This level of instability is always present in all conventional drilling machines, and is perfectly tolerable in conventional drilling with larger drills. However, it must be reduced by a full order of magnitude before adequate productivity can be achieved with drills the diameter of a human hair.

Machine instability

Drilling machine instability manifests itself in both the vertical and the horizontal axes. Both cause small bits to break.

Vertical or Z-axis instability causes torsional breakage induced by changes in the chip load during the drilling stroke, and horizontal (X-Y) plane instability subjects small bits to intolerable bending stresses.

In modern high-speed, high-feed drilling machines, the magnitude of these instabilities has been reduced to a level that is not detrimental to large- and medium-size drill bits. But it cannot be further reduced within the constraints of existing machine architecture to protect small, fragile drills operating at the production speeds required by the contem-



The Pluritec 'Selecta 2400' drilling machine, which incorporates the advanced technology discussed in this article. (Courtesy IPP)

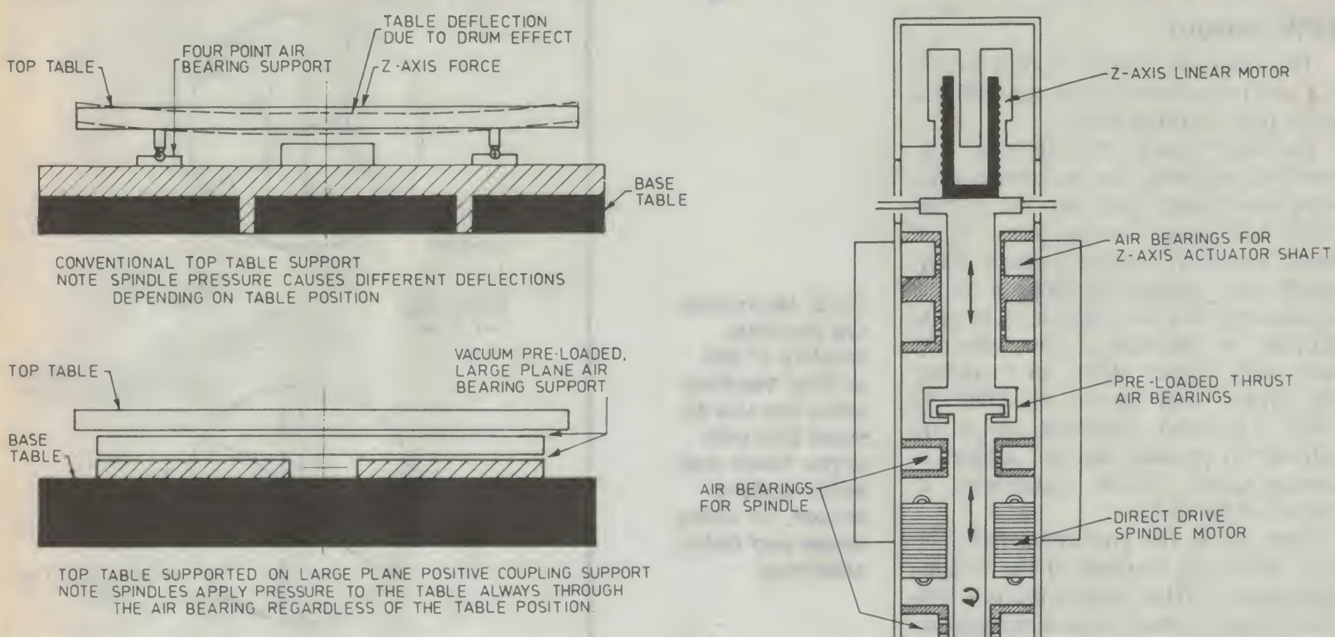


Fig.1 (above): A large plane air bearing prevents deflection of the drilling table. Fig.2 (right): Pluritec's direct drive spindle uses air bearings and a linear motor for Z-axis drive.

porary market. That task demands dramatic changes in drilling machine architecture.

Z-axis instability

There are two significant factors in Z-axis instability: table deflection and Z-axis drive vibration.

Table deflection refers to the tendency of a four-point-supported worktable to give way, or arc downward, in a 'drum-effect' response to the pressure of the drilling stroke, and then to spring back upward as the initial pressure decreases, causing chip-load irregularities sufficient to break small drill bits (Fig.1).

The indicated solution to the problem of table deflection is to replace four-point table support with uniformly pre-loaded, large-area support. Such a positive-coupled system requires a pre-loaded frictionless area support, to give the moving member maximum rigidity.

This is achieved by supporting the X-Y positioning table on an air bearing alternating with pre-loaded vacuum chambers under the whole table area, giving the moving table the stiffness of the base table. The impact of the pressure-foot during the down-stroke is therefore distributed over the full base-table area, reducing to negligible magnitude the deflection of the table and the resulting chip-load irregularities that produce torsional breakage of the drill. In addition, positive coupling eliminates the need for a still positioning table, permitting a significant reduction in the weight of the moving member, and thus greatly improving overall system dynamics.

Z-drive instability

Indirect Z-axis drives with many components and pivot points create multiple opportunities for the development of cumulative backlash and consequent drive instability manifested as Z-axis vibration sufficient to destroy small drill bits.

Indirect drive is popular on conventional drilling machines because it is both economical and stable enough to produce quality holes in the standard drill size range. However, the prospect of developing an indirect drive that is stable enough to protect small bits in high-productivity operations does not appear to be a promising one.

A far more practical solution is to design direct-drive spindles in which drilling motion is applied directly in the rotating shaft rather than to the entire spindle and spindle-guide system. This design eliminates many transition points, which are a source of deflection and backlash, and consequently of linear instability.

In the direct-drive spindle, (Fig.2) a linear motor, directly linked to the rotating shaft through pre-loaded thrust air bearings, provides linear motion to the drill bit. Combining these functions in a single direct drive reduces the complexity and moving mass of the spindle by one order of magnitude – a standard indirect-drive spindle and guides weighing twenty pounds (9kg) or more can be replaced by a directly driven spindle shaft weighing 1.5 pounds (0.7kg).

The overall impact of such a mechanism on the drilling machine structure is reduced by a factor of more than 12, producing proportionately smaller machine deflections thoughout. This reduction in moving mass and elimination of pivot points provides the stability required for the protection of small drills in high throughput operations.

Direct drive, in addition, permits short coupling of the spindle shaft to position and velocity feedback mechanisms, which provides an additional stability bonus. This produces a constant Z-axis drive velocity, making possible high chip loads of .0015″ or 0.38mm per turn with .006″ or 0.15mm diameter drill bits operating at up to 120,000rpm, without drill breakage.

Advances in PCB drilling

Drill runout

The principle source of drill runout (i.e.,drift off centre) is the conventional taper type chucking device.

The taper chuck used on most conventional machines has an internal actuating mechanism built into the spindle shaft with many moving parts, all of which can move relative to each other, which may change the balance of the mechanism. For this reason, it is quite difficult to maintain a low vibration level with a taper chuck, or to reduce the typical drill runout of .0005″ to .0007″ (.013mm). Matching tapers are difficult to produce and are subject to contamination, which contributes to runout of the drill.

Once again, the problem defies solution within the confines of the existing architecture. What is required is a simplified passive chuck with centrifugal actuation and low runout that is just now emerging. The new unibody high-leverage centrifugal chuck is a one-piece device of superior dynamic design that replaces multipart design with a simple high-leverage flexure action and shrinks runout to the neighbourhood of .0001″ (.0025mm).

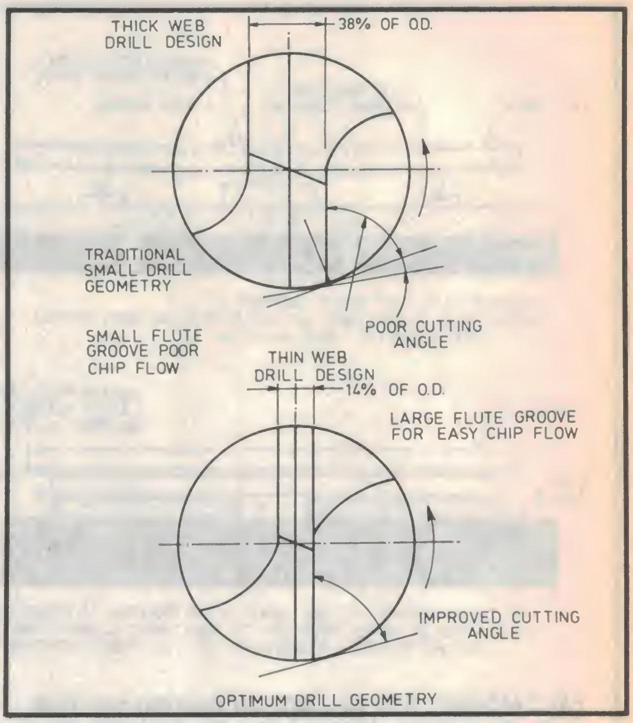


Fig.3: Improving the dynamic stability of the drilling machine allow the use of small bits with larger flutes and better cutting angles, for lower stress and better efficiency.

Drill bit architecture

The first response of drill-bit manufacturers to the high level of breakage encountered drilling small holes with conventional drilling equipment was to strengthen the bits, by increasing web thickness. The consequence of this strategy, however, was to reduce the depth of the flute grooves, providing a shallower channel for chip removal. The re-

sult was a drill bit of inferior cutting performance, that was actually subjected to *greater* torsional stress because of chip crowding in the more constricted flute grooves. In addition, this geometry presented a negative cutting angle, which further deteriorated cutting conditions and contributed to poor hole quality (Fig.3).

Increasing the dynamic stability of small-hole drilling machines permits a return to bits designed for effective cutting, reduced torsion stress on the bit during drilling, and improved hole quality, while creating conditions necessary for high feed rates.

Drill bit packaging

Not only are small drill bits more easily damaged in handling and operation than those of conventional size, they are also more difficult and expensive to manufacture, and therefore cost up to five times as much as large- and medium-size bits. Providing maximum protection for small bits is thus a matter of considerable economic importance for the user.

Fig.4: Modified small drill bit geometry, with reference surfaces ground into the shank for precise location in the holder.

This is especially true in the light of the extreme fragility of many small drill bits, which can be broken by a careless touch. The mortality rate in routine handling – loading them in collars and inserting them in holders – is therefore quite high. In addition, they are quite sensitive to drilling depth, increasing the importance of exact collet positioning, further increasing the danger of damage during handling.

A great deal of effort has therefore been devoted to new packaging methods that will eliminate handling of small drill bits. The new package includes a new drill geometry, (Fig.4) with surfaces ground into the shank that not only control the amount of drill protrusion, but also permit automatic tool changing without collars.

The finished drills are packaged by the manufacturer in special 6-position tool clips (Fig.5) and secured in place under a sliding cover that provides complete protection under all normal shipping, storage and handling operations.

The tool clip is also designed to be inserted directly into the drilling machine tool-changer magazine. The drill bits remain securely held in their sockets until removed by the tool changer. The only manual handling required is

the removal of the sliding protective cover and insertion of the clip in the tool changer. There is no need for the drills to be handled separately at any time, thus eliminating a major source of damage.

One additional advantage accrues from the elimination of collars, which prevents the drill head pressure-foot from clamping very close to the edge of the hole target. As a result, there is a tendency in thin panels for the material to lift – the 'oil-can effect' (Fig.6) – during the drilling operation. With the elimination of the collars, the foot can clamp the material immediately adjacent to the hole edge, thus eliminating oil-canning.

Summary

Drilling equipment manufacturers are only now beginning to respond to industry demands for high-productivity small-hole drilling for the new requirements of surface-mounted technology. Small-hole drilling calls for a new drilling-machine architecture, to raise productivity levels and protect fragile small drill bits against damage during handling and drilling operations.

Much of the work has now been done to improve the architecture of drilling-machines, making possible an increase of small-hole drilling productivity by a magnitude of 2-3 times. Rates of 250 bits per minute with a 0.15mm diameter drill bit are now possible on a production basis, bringing the equipment much closer to ultimate industry needs.

Footnote: The above article is based on information supplied by leading Italian PCB drilling equipment manufacturer Pluritec Italia, and also published in the Italian magazine 'PCB'. Our thanks to local Pluritec distributor International Precision Products for their assistance. Further information on the Pluritec range of high speed, high precision PCB drilling systems is available from IPP at Cnr Haig Street and Windsor Road, Croydon 3136, or phone (03) 725 9666.

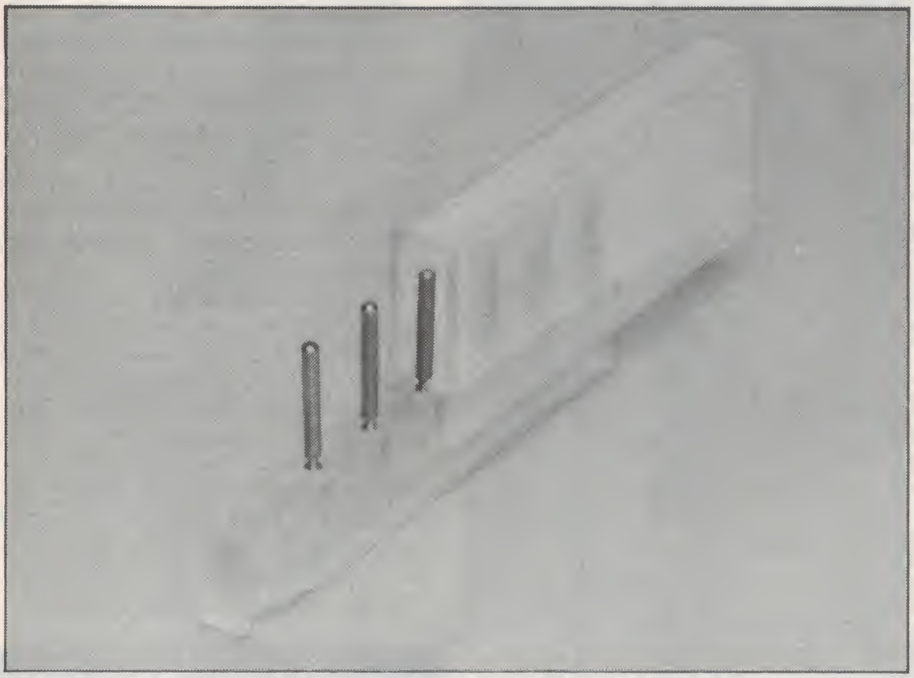
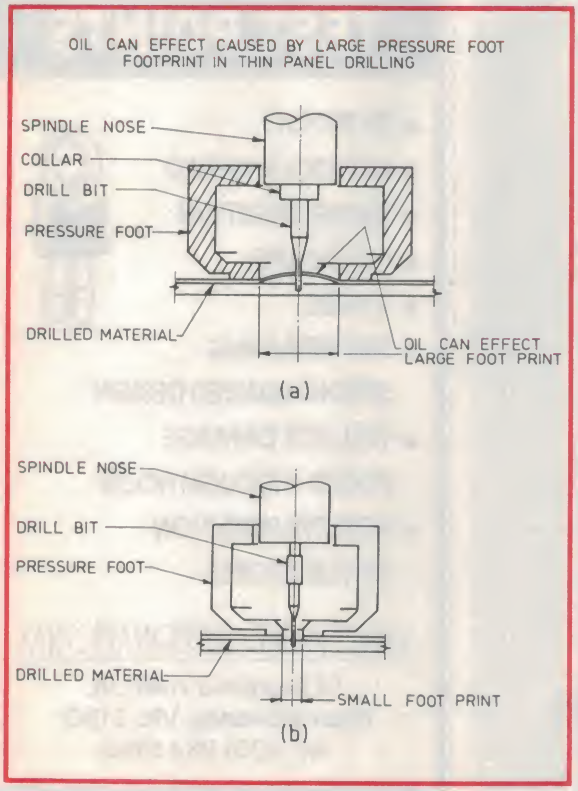


Fig.5(a): Drills are packed 6-up in a special clip, for protection.



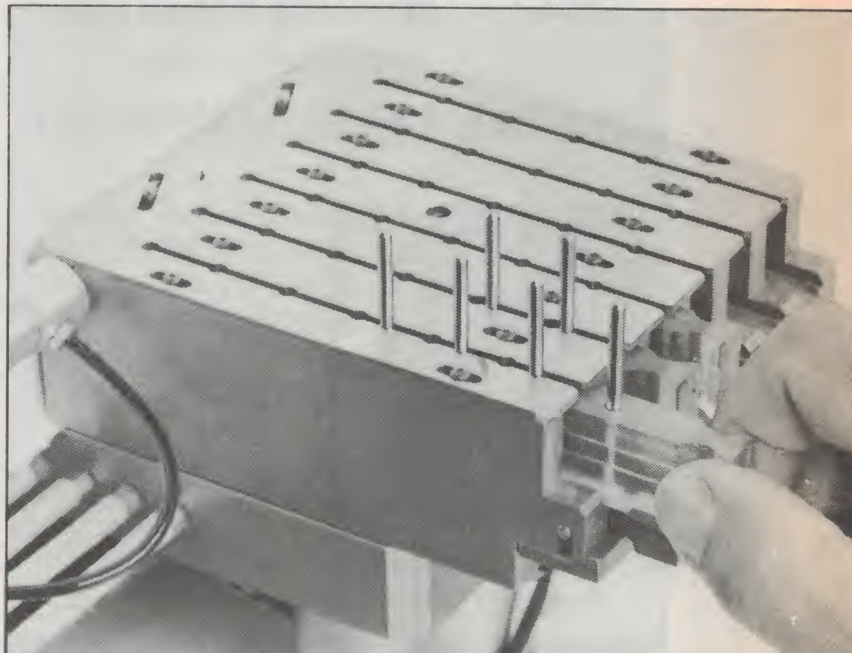


Fig.5(b): The automatic tool changer magazine accepts 6 drill clips. There is no manual handling of fragile bits.

Fig.6: With spindle collars eliminated, the drill head pressure foot can have a smaller aperture, preventing 'oil-can' effect.

PCB Feature:

Designing PCBs for surface mounting

The requirements for PCB designs using surface mount devices are different from those using conventional leaded parts, and this can pose problems when you're using CAD systems...

by SHAUN MURRAY

The electronics industry has been experiencing a changeover during the past several years, due to the introduction of surface mount devices (SMD's). SMD's already either co-exist or have replaced traditional leaded components, and can be found in a wide range of imported products – from VCR's, video cameras and telecommunications equipment to computers and control systems.

The reason for this growing SMD popularity is that they offer a means to significantly reduce the PCB volume. SMD's allow greater functionality to be packed into a smaller volume of board area or profile, depending on specific circumstances. In many applications, size is an important product feature, and a premium in cost is acceptable in order to produce smaller systems.

Leaded components have been the predominant packaging technique since their introduction. Therefore there are important economics of scale and investment in manufacturing equipment supporting traditional components, factors that can make them a less expensive packaging method than SMD's. Also, leaded components are relatively easy to replace if found to be defective, and boards using leaded components are catered for by all PCB fabrication and assembly shops.

Another problem can arise with the introduction of SMD's, when CAD systems are used. Many CAD systems do not perform as well for SMD design as they do for leaded components, for which they were primarily designed.

RCS Design in Melbourne decided to meet these problems head on, by taking on Racal-Redac's Cadstar, an integrated software package which has been designed to handle the requirements of SMD type boards. Cadstar runs on any IBM PS/2, PC-AT or compatible machine with the performance of a sophisticated workstation.

To be effective for SMD design, a CAD system must have a resolution of 0.001". Cadstar has been designed with the ability to handle up to 3500 connections per board, 16 track layers and a thousandth of an inch resolution grid. Designers can create true component shapes with up to 256 pins.

CAD systems typically offer automatic and interactive component placement routines, but automatic placement is frequently limited to one layer, which does not cater for the possibility that SMD's can be placed on both sides of a board.

Cadstar supports automatic placement on both layers; the designer can specify different placement grids and areas for either side of the board. Also the creating of separate component symbols for opposite sides of the board is now eliminated, for the Cadstar system enables the designer to interactively mirror the component shape to be used on the opposite side to which it was created.

SMD technology presents, perhaps, its greatest challenge to CAD systems in the area of automatic routing. Firstly, SMD's are almost always routed using fine-line design rules. The rules make use of the usual DIP grids impossible. Secondly, SMD's have variations in pitch which are very difficult for uniform grid based routers to handle. Thirdly, SMD integrated circuits are in the middle of a routing area, are more densely packed, and can have connections on all four sides.

All tracks exiting the SMD must exit on a single layer, even though the preferred direction could well be on another layer. Because of this, most routers' results are typically poor when a large number of SMD's populate the board. The router must recognise that components are surface mounted and that there is a space available on other layers for tracks to run under pads.

The data structure of Cadstar does not rely on a uniform grid and is therefore able to handle any variations in pitch. Also obstacles are represented accurately, which frees space for route tracks.

Another aid to efficient routing is Cadstar's ability to swap gates within or between components, and to swap connections between component terminals. This reduces the connection length of a layout, improving the routing quality. Other routing facilities include automatic power and ground layers, memory and orthogonal routing, a fine line grid selectable auto-router and a fast via-minimisation routine.

Finally, with Cadstar, users have the facilities to produce professional 'right-first-time' board designs that can be reliably manufactured and serviced. The interactive use of manual and automatic routines gives the user complete control, as well as flexibility to design practical boards for volume production. Thus user productivity increases and PCB design time is shortened, resulting in greater overall profitability.

The author Shaun Murray is a PCB designer at RCS Design, one of Australia's leading CAD and plotting bureaux. RCS Design is also Victorian/Tasmanian distributor for Racal's Cadstar and Redlog/Redboard PCB design software. For more details about Cadstar contact RCS Design at 728 Heidelberg Road, Alphington, 3078 or phone (03) 49 6404.

PCB Feature:

Australian–made ATE system for PCB testing

A low cost PC-based ATE system for PCB testing, developed and manufactured in Sydney is proving a very attractive alternative to large and expensive overseas systems.

Binary Engineering's CTS-88 circuit test system has been developed to meet the three main areas of circuit board testing – manufacturing defects analysis, in-circuit testing and full functional checking.

Major appeal of the CTS is its ready adaptability to almost any requirement, through the selection of plug in modules which perform the various tests.

According to managing director Tony Richardson, 'the CTS-88 is simply an automatic representation of all the test equipment normally found on a workbench or production line. They can be used individually, or as part of a fully automatic test sequence – depending on the programming used'.

All programming is written in an enhanced form of BASIC (although for speed it runs under 'C'). This is a major advantage as most users have a good understanding of the language and can

start writing routines with virtually no training. Many of the tests are simple 'one liners' which are held in Binary's Test Language Library.

Binary claims that the CTS-88 is suitable for the smallest operation, whether in manufacturing or service applications, right through to the large user seeking a fully networked system. For the latter, a CTS-88 networking system using an Ethernet or Token Ring LAN has just been released. The potential bottleneck of a single large system is removed, allowing parallel testing with centralised software, reporting and system development.

With four to six work stations, downtime due to jig changes can be substantially reduced while program development can be carried out off line. This means that programs can be debugged before applying them to the test work station. All program entries and amendments can be closely controlled through the use of passwords, appropriate codes, batch and serial numbers. Management control is focussed through the use of a centralised file server, so that a single change encompasses all users.

The open architecture of the CTS-88 in a modular format ensures that systems can be configured to suit individual requirements. With the larger imported systems this flexibility is not available. Phased updating of the CTS-88 means that the system can grow over the years and incorporate new developments and technological improvements. The user does not reach the point where his system becomes totally obsolete!

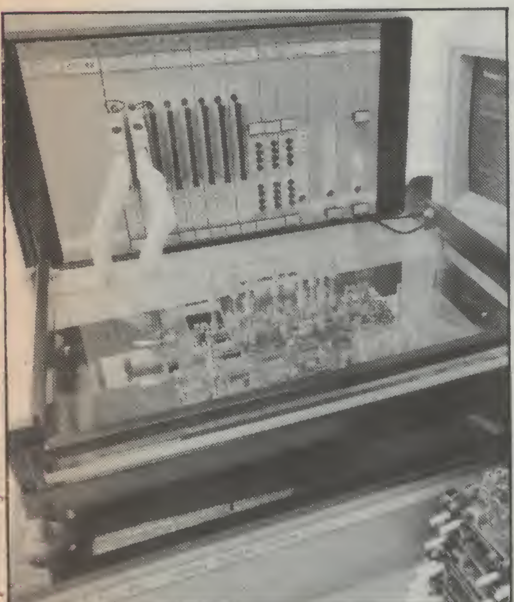
Binary believe they have thoroughly researched the market to provide the accuracy and performance sought by 95% of potential users. They have adopted this approach rather than an overkill which would only suit the remaining 5%.

To date some ten systems have been sold, with applications as diverse as the manufacture of radio and satellite systems through to alarm electronics.

The range of cards available includes a programmable digital voltmeter, a guarded measurement card, programmable power supplies, a function generator, digital I/O cards, a microsystem test interface, relay multiplexers and a user programmable breadboard.

A comprehensive range of software using an enhanced form of BASIC also includes the newly developed automatic test program generator.

Further information is available from Binary Engineering Pty Ltd, 75 Old Pittwater Road, Brookvale 2100. Telephone (02) 938 5344.



Above: Binary Engineering's CTS-88 PCB tester as set up for functional testing of an assembled board.

Left: Inserting a board for testing, with the top of the test jig swung up for access. (Pictures courtesy Binary Engineering)

PCB Feature:

New PCB Products

Peelable solder mask

OC Flex Mask, a peelable solder mask, is a new formulation developed by Contronic Devices to protect contacts, terminals and plated-through holes during the wave solder process. Easily applied from the bottle, PC Flex Mask dries quickly, protecting desired areas of the circuit board. No hazardous chemicals, no gummy clean-up, no solder creepage. The high temperature mask peels easily, leaving no residue on the surface of the board.

PC Flex Mask is available in 8oz, 16oz and 1 US gallon containers.

For more information contact Meltec, PO Box 20, Greenacre 2190.

Wave soldering monitor

Electronic Controls Design announces Flowtrack II, a new compact and low cost wave soldering monitor and flux controller.

Small enough to mount directly on the wave-soldering machine, Flowtrack II can be directly wired into the machine's electrical system to make it a permanent part of the system.

Like Flowtrack, its highly successful big brother Flowtrack II monitors all the vital functions of any wave soldering system and prints out the data on its integral thermal printer. The machine parameters monitored and recorded include solder-wave temperature, preheat temperatures, exhaust stack temperature, solder pot temperature (all temperatures in either Fahrenheit or Celsius), conveyor speed and date. In addition Flowtrack II automatically controls the density of the flux (with temperature compensation) and monitors other flux characteristics such as temperature, level and air stone pressure.

High and low alarms are included on all data channels, and all data are displayed on the easy-to-read vacuum-fluorescent display and printed out on the high-quality built in printer. An RS-232 port is also included as standard equipment to allow downloading to your PC or other computerised production control system.

Further details from Meltec, PO Box 20, Greenacre 2190. Phone (02) 708 4300.

PCB shorts locator

The Polar 850 shorts locator now allows you to pin point short circuits on PCBs, in a fraction of the time it normally takes.

By locating solder bridges, etching defects, faulty ICs or faulty decoupling

SMT/PCB production equipment

Ersa, which claims to have invented the electric soldering process back in 1928, has recently released a comprehensive new range of SMT/PCB production and prototyping equipment.

The ESS 8000 is a compact yet sophisticated SMD pick and place small run or prototyping machine. It incorporates a circular indexing dispenser for loose SMT components, as well as tube and package dispensers. The ESS 8000 performs all the necessary functions including pick and place, epoxy and or solder paste dispensing and then finally will hot air reflow solder. The unit is fully self contained and competitively priced.

The ERS range of infra-red reflow soldering machines have been tried and proven in the United States market for

capacitors, the 850 also eliminates the need to cut tracks in order to isolate the fault.

The 850 employs three different techniques to help you track down short circuits in electronic assemblies. First, the instrument's 2m ohm ranges, with full ranges of 40m ohm and 200m ohm, allow you to locate shorts between PC-board traces or component legs by finding the point of minimum resistance. Second, for higher resistance faults, a 2mV range with uV resolution allows you to trace current flow along PC-board traces. Finally, a magnetic field sensing current probe allows you to trace inaccessible current paths e.g., through ICs or through buried tracks in multilayer PC-boards.

A variable pitch tone and a digital display are used to guide the user closer to the short location. The advantage of this tone guidance method is that it can be used by semi-skilled operators.

When used with an ATE printout from a rejected PCB, the 850 also offers major productivity improvements by allowing rapid and accurate physical location of the defect.

Further details from Emona Instruments, 86 Parramatta Road, Camperdown 2050.

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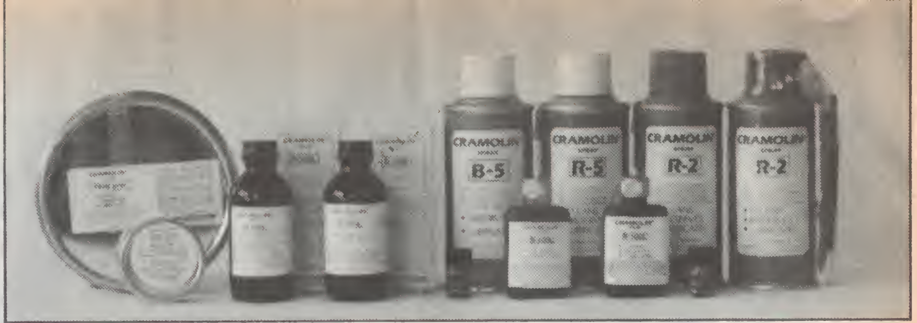
the last four years. There are four basic models available, with soldering widths of 100mm, 220mm, 300mm and 450mm. The ERS 100 is a compact bench-top type infrared reflow machine with a chain band belt of 100mm width. This unit comes with two lower and one upper heating zone, each independently adjustable.

The ERS 220 has an operating width of 220mm and features a microprocessor controller. This controller enables you to store up to 450 different soldering programs, for random recall. The unit can also be connected to an IBM compatible computer and printer via an RS-232C interface. There are seven individually adjustable heating zones, as well as a twin fan cooling zone and an optional ultra-violet zone.

The ERS 300 and ERS 450 are both very similar in specification to the ERS 220 except for the maximum operating widths being 300mm and 450mm respectively.

These machines supplement an already wide range of specialised soldering equipment manufactured by Ersa. For further information, please contact Meltec at 15-17 Beresford Avenue, Greenacre 2190 or phone (02) 708 4300 for the name of your local agent.



Cleaner/lubricants

A new product released by Caig Laboratories is the Electronic Maintenance Kit, combining the cleaning action of Cramolin Red with the added preservative benefits of Cramolin Blue. The kit is packed in an easy to carry perspex case and includes a 2dram bottle of Cramolin Red, a 2dram bottle of Cramolin Blue, lint-free cloths, brushes, swabs and instructions.

Corrosive atmospheric compounds coat metal connections with non-conducting oxide films, increasing contact resistance until the resistive film is so thick that intermittent signals or complete failure results. Cramolin Red liquid dissolves oxide films, leaves a long lasting protective layer, and can be used on switches, relays, PCB connectors, potentiometers interconnecting cables and other applications.

Cramolin Red liquid is a fast-acting, anti-oxidising lubricant that cleans and preserves electrical contacts and connectors. Cramolin Blue liquid is a lubricant that preserves newly manufactured contacts and connectors or ones precleaned with Cramolin Red liquid. Cramolin Blue provides superior lubricating and protecting qualities for areas with high concentration of contaminants (ammonia, salts, etc).

Cramolin Sprays provide a 2% or 5% concentration of Cramolin Red and Cramolin Blue solution for those hard to reach faders, patchbays, and switches while still providing cleaning and preservation of these connectors.

Cramolin Pastes Type 81 are semi-solid forms of Cramolin Red used as a combination lubricating, cleaning and protection preparation, used on high amperage/high voltage and adverse environmental applications.

Further details from Connetics, 76 Hampden Road, Artarmon 2064 or phone (02) 411 6669.

PCB fault tracer

The Toneohm 700 is a PCB fault tracer that instantly detects and locates short circuits, devices loading down Vcc and bus and multilayer circuit faults. It can be used for both analog and digital circuits.

The unit combines the milliohmmeter (100uohm resolution) and current probe capabilities of the existing Toneohm 550 and 580 instruments, and in addition features a mirovoltmeter sensitive enough to measure the voltage drop along a PCB track.

When probing the shorted track with the milliohm range, the Toneohm 700 produces an audio tone which rises in frequency as the probes are moved closer to the short. The point of highest frequency output will be within 2 to 3mm of the physical short. Special Kelvin needle probes and a maximum probe tip voltage of 60mV ensures high resolution and no danger to components.

For multilayer and bus faults, the Toneohm has a sensitive magnetic field probe, working with an on-board drive source, which can detect current flow inside an IC, a shorted capacitor or within the layers of a multilayer PCB. Shorts and partial shorts can be located by following the current flow. Where several devices are connected to an address or data bus, the faulty one can be quickly located.

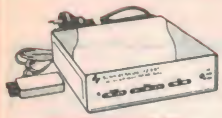
The Toneohm 700 measures voltage with 1uV resolution. When used in conjunction with the audio tone feature, the path of the DC current can be followed along a PCB track by monitoring the voltage drop. Among the applications of this feature is the detection of a device loading down the board's Vcc line.

Further details from Emona Instruments, 86 Parramatta Road, Camperdown 2050.

PCB racking

PC Rack Master is a new adjustable, high density polythylene circuit board rack designed to prevent damage to PC boards during assembly, interplant transfer and storage. Manufactured by Contronic Devices, each PC Rack Master quickly adjusts to a wide variety of board sizes with fast and easy insertion of up to 25 boards per rack. For ESD control, PC Rack Master is also available in anti-static blue polythylene.

For more information contact Meltec, PO Box 20, Greenacre 2190.

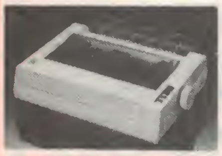


SCHMIDT 123AT MULTI STANDARD MODEM

- V21,V22,V23 Multi standard modem (300/300, 1200/1200, 1200/75)
- Auto dial "AT" command set (Hayes* compatible)
- Auto answer/auto disconnect
- Auto answerback (Similar to Telex)
- Auto or manual control
- Dial-up or leased line operation
- Pulse or Tone Dialing
- Automatic speed ranging
- Speaker for call progress monitoring
- Baud-rate converter with 48 character buffer (V23)
- Synchronous or asynchronous operation
- Fully self contained power supply
- Low power operation
- Metal case (R.F. shielded)
- Visual monitoring of important interface circuits (7 LED's)
- Full or half duplex (V23)
- Double adaptor plug to allow use of standard phone (Mode 1/3/5)
- Telecom Authorised (C87/37/65)

.... **$595**

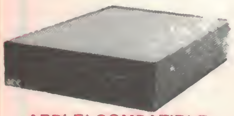
*Hayes is a trademark of Hayes Microcomputer Products Inc.



PANASONIC KX-P1081 DOT MATRIX PRINTER

- 120 C.P.S.
- Pica or Elite character set
- Print Modes: NLQ, Dot Graphics, Proportional Font, Draft.
- Proportional Printing
- Reliable and Compact
- Proportional Printing
- Logic Seeking
- 1K Printer Buffer

Cat. C20035 .... **only $595**



APPLE* COMPATIBLE SLIMLINE DISK DRIVE

Compatible with Apple 2+
Cat. X19901 .... Normally $225
SPECIAL $179

APPLE* IIC COMPATIBLE DISK DRIVE

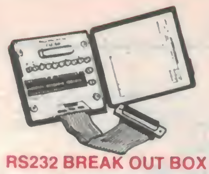
(including cable ...... **only $199**

SAMSUNG TTL 12" MONITOR

- High contrast, non-glare screen
- Excellent value for money!

SPECIFICATIONS:
Picture tube: 12" diagonal 90° deflection
Mode: TTL
TTL input signal:
Polarity: TTL Positive
Level: 4V p-p + −1·5V
Impedance: 75ohm
Video bandwidth: 16MHz (−3dB)
Scanning frequency:
Horizontal: 18·432 + −0·1KHz
Vertical: 50HZ + −0·5%
Active display area: 216(H) x 160(V)mm
Display characters: 80 characters x 25 lines
Input connector: 9 pin connector
Controls:
Front; Power ON/OFF, Contrast.
Rear; V-Hold, V-Size, Brightness
Internal; Vertical Linearity, Horizontal Linearity, Horizontal Width, Focus.
Power supply: 110/120V 60Hz, 220/240V 50 Hz
Dimensions: 308(W) x 297(H) x 307(L)mm
Weight: 7·3Kg
Shipping weight: 8·3Kg

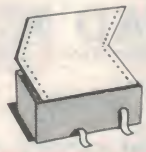
Cat.No.	Description	Price
X14500	(GREEN)	$189
X14502	(AMBER)	$189



RS232 BREAK OUT BOX

A simple way of monitoring RS232 interface lead activity. Interface powered, pocket size for circuit testing, monitoring and patching. 10 signal powered LED's and 2 spares. 24 switches enables you to break out circuits or reconfigure and patch any or all the 24 active positions.

SPECIFICATIONS:
Connectors: DB25 plug on 80mm ribbon cable and DB25 socket.
Indicators: Tricolour LED's for TD, RD, RTS, CTS, DSR, CD, TC, RC, DTR, (E)TC.
Jumper Wires: 20 tinned end pieces.
Power: Interface power.
Enclosure: Black, high impact plastic.
Dimensions: 85 x 95 x 30mm
X15700 .... **$94.95**



COMPUTER PAPER

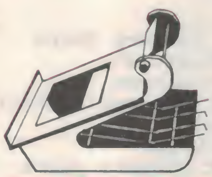
Quality paper at a low price! 2,000 sheets of 70 gsm bond paper.
Cat. C21003 11 x 9½" ... **$39.95**
Cat. C21005 15 x 11" **$67.95**

★★★★★★★★

STOP PRESS!

GOLDSTAR TTL MONITORS ONLY $149
THIS MONTH ONLY!

★★★★★★★★



DELUXE PRINTER STAND

- Restores order to your work area without occupying extra space.
- Feeds and refolds paper under the printer automatically
- Adjustable paper deflectors ensure smooth flow of paper.
- Made of moulded plastic
- Suitable for most printers

C21058 (80 column) **$69.95**

RITRON 2 MONITORS

Stylish monitors available in green or amber displays and featuring swivel base that tilts forward and back 30 degrees and swivels right to left 60 degrees!

SPECIFICATIONS:
CRT DISPLAY SIZE: 12 Inches non-glare 90 degree deflection.
INPUT SIGNAL: 1.0 - 2.5V p-p composite video signal.
INPUT INPEDANCE: Normal 75 ohm, high approx. 50K ohm.
INPUT TERMINALS: RCA phone jack.
RISE AND FALL TIME: Less than 25 us
VIDEO BANDWIDTH: 20MHz
Corner; 800 lines
Geometric distortion; 2% or less
Linearity; less than 2%
CONTROLS: Front; Power On/Off, brightness, contrast
Rear; Vertical hold, Horizontal hold, Vertical line, Vertical size.

Green Cat. X14506..**Normally $235**
Amber Cat. X14508..**Normally $239**
NOW ONLY $169

THE BUTTON SPIKE PROTECTOR

Surges and spikes are caused not only by lightning strikes and load switching but also by other equipment being switched on and off, such as fluorescent lights, electric motors, fridge freezers, air conditioners, etc.

For effective protection such spikes must be stopped before they reach your equipment. Simply plug The Button into an outlet and it will protect all equipment plugged into adjacent outlets on the same branch circuit. The Button employs unique metal oxide varister technology and will dissipate 150 joules of electrical energy. (nearly twice that of comparable surge arresters.)

SPECIFICATIONS:
Voltage: 240V Nominal
Total Energy Rating: 150 joules
Response Time: 10ns
Protection Level: 350V peak
.... **$34.95**

COMPUTER CABLE

CIC6 6 conductor computer interface cable. Colour coded with braided shield. (to IE422 specifications). Copper conductor 6 x 7/0.16mm.

1-9 metres	10+ metres
$1.90/m	$1.70/m

CIC9.100 9 conductor computer interface cable. Colour coded with mylar shielding. 9 x 7/0.16mm.

1-9 metres	10+ metres
$2.50/m	$1.95/m

CIC12 12 conductor computer interface cable. Colour coded with mylar shielding. 12 x 7/0.16mm.

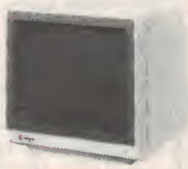
1-9 metres	10+ metres
$2.70/m	$2.50/m

CIC16 16 conductor computer interface cable. Colour coded with mylar shielding. 16 x 7/0.16mm.

1-9 metres	10+ metres
$3.90/m	$3.40/m

CIC25 25 conductor computer interface cable. Colour coded with mylar shielding. 25 x 7/0.16mm.

1-9 metres	10+ metres
$4.90/m	$4.40/m

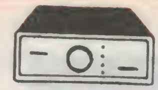


SAMSUNG 12" TTL/COMPOSITE MONITOR ONLY $179

FEATURES....
- At last a monitor with both TTL and Composite modes!
- High contrast, non-glare screen
- High resolution, 80 or 40 character display
- Swivel/Tilt base

SPECIFICATIONS....
Picture tube: 12" diagonal and 90° deflection
Phosphor: Green (P42)
Video input signal: Composite/TTL Switchable
Polarity: Negative/Positive
Level: 0·5 - 2·0Vp-p/4·0 + −1·5Vp-p
Impedance: 75ohm, more than 6·8K ohm
Scanning frequency:
Horizontal: 15·75 KHz + −0·1%/18·432KHz + −0·1%
Vertical: 47-63Hz
Video bandwidth: 20MHz
Active display area:
Composite: 206(H) x 160(V)mm.
TTL: 216(H) x 160(V)mm
Display character: 80 characters x 25 rows.
Input terminal: Phono Pin Jack, 9 pin D-Sub Connector.
Controls:
Outside: Power Switch, Contrast, Brightness, Signal Select, V-Hold, V-Size.
Inside: H-Width, H/V linearity, Focus, H/V-Shift.
Power supply: 110/120V 60Hz, 220/240V 50Hz
Dimensions: 308(W) x 297(H) x 307(L)mm
Weight: 7·3 Kg
Shipping weight: 8·3 Kg

Cat.No.	Description	Price
X14509	(GREEN)	$179



2 & 4 WAY RS232 DATA TRANSFER SWITCHES

If you have two or four compatible devices that need to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around.
- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector

2 WAY Cat.X19120 **only $59**
4 WAY Cat.X19125 **only $99**

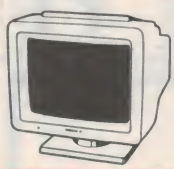
2 & 4 WAY CENTRONICS DATA TRANSFER SWITCHES

Save time and hassles of constantly changing cables and leads around with these inexpensive data transfer switches. These data switches support the 36 pin centronic interface used by Centronics, Printronics, Data Products, Epson, Micronics, Star, and many other printer manufacturers.
- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector
- Bale locks are standard

2 WAY (X19130) ...... **only $59**
4 WAY (X19135) ...... **only $99**

VERBATIM HARD DISK CARD

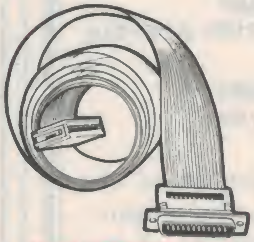
Available 20 or 30 M/Byte! IBM* compatible, plugs straight in to your computers bus connectors!
X20020 .... **$955**
X20030 .... **$1,095**



THOMSON EGA MONITOR

Top quality high resolution EGA monitors with a space-age design.

SPECIFICATIONS:
CRT: 14 inch (360mm) diagonal, 90 degree deflection.
Display Size: 245(H) x 180(V)mm
Phosphor: P22, non glare, tinted screen.
Dot Pitch: 0.31mm
Video Bandwidth: 18 MHz
Resolution: 15·75KHz - 640 x 200, 21·85KHz 640 x 350
Input Signals:
1. RGBI - positive, H(+), V(+)
2. RrGgBbI - positive, H(+), V(−)
Input Impedance: TTL Level (330 ohms)
Dual Scanning Frequency:
Horizontal: 15·75 KHz or 21·85 KHz + −10Hz
Vertical: 50 - 60 Hz
Connector: 9 pin, D-type
Size: 312(H) x 363(L) x 380(W)mm
Weight: 10·8 Kg (Net)
X14525 .... **$895**



5¼" FLOPPY DISK DRIVE EXTENSION CABLE

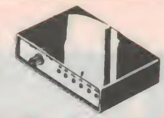
- IBM* compatible
- DB37 Male to 34 way edge connector
- Length 0·5 metres

P19045 .... **$99.95**

3½" FLOPPY DISK DRIVE EXTENSION CABLE

- IBM* compatible
- DB37 Male to 34 IDC connector
- Length 0·5 metres

P19046 .... **$99.95**



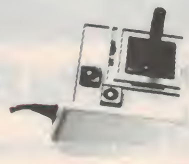
RS232 DATA SWITCH WITH TESTER

- No power required
- Ideal for 1 computer to 2 peripherals or 2 computers to one peripheral.
- 25 pin RS232 "D" connectors.
- Six dual coloured LED indicators showing certain flow status:

T.D. Transmit Data
R.D. Receive Data
R.T.S. Request To Send
C.T.S. Slear To Send
D.S.R. Data Set Ready
D.T.R. Data Terminal Ready

- Size: 200(W) x 68(H) x 150(D)mm

Cat.X19110 .... **R.R.P. $169**
Our Price $149



JOYSTICK FOR IBM

Features Selectable "Spring centenng" or "free floating". Electrical trim adjustments on both axis. 360 degree cursor control
Cat. C14205 .... **$39.95**

★★★★★★★★

GENUINE CANON LASER CARTRIDGES

EP R340002 Cartridge: For Canon and HP Laserjet.
EP-S R640002 Cartridge: For Canon and HP Series 2 Laserjets.
.... **each $210**

★★★★★★★★

3½" EXTERNAL DRIVE

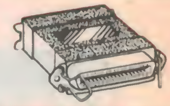
- 720K formatted capacity
- 37 way D type connector fits directly onto drive controller card.
- Compatible with IBM* PC/XT
- Requires DOS 3·2 or greater.
- Size: 266(D) x 104(W) x 75(H)mm

.... **only $395**

COPY HOLDER (YU-H33)

- Copy area 9½" x 11"
- Sliding line guide
- Flat metal base

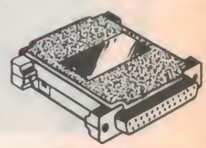
C21060 .... **$39.95**



CENTRONICS GENDER CHANGERS

- Female to Female.
- Saves modifying or replacing non-mating Centronics cables.
- All 36 pins wired straight through.

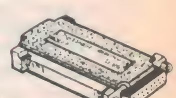
Cat. X15663 **Male to Male**
Cat. X15661 **Male to Female**
Cat. X15664 **Female to Female**
Normally $33.95.
Only $24.95



RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables.
- All 25 pins wired straight through

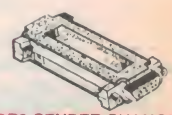
Cat. X15650 **Male to Male**
Cat. X15651 **Male to Female**
Cat. X15652 **Female to Female**
Normally $14.95 each
Only $9.95



DB15 GENDER CHANGERS

- Saves modifying or replacing non mating DB15 connections.
- All 15 pins wired straight through

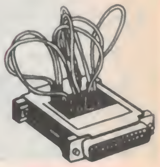
X15645: Male to male
X15646: Male to Female
X15647: Female to Female
.... **only $14.95**



DB9 GENDER CHANGERS

- Saves modifying or replacing non mating DB9 connections.
- All 9 pins wired straight through

X15640: Male to male
X15641: Male to Female
X15642: Female to Female
.... **only $14.95**



RS232 WIRING ADAPTOR BOX

- Male to female
- 25 Detachable plug on leads
- 2 mini jumpers
- Ideal for experimenting or temporary connections

Cat. X15665 ...... **Normally $49.95**
Only $44.95

RS232 MINI TESTER

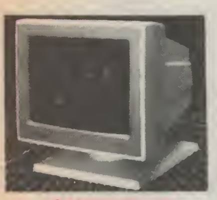
- Male to female connections
- All pin wired straight through
- Dual colour LED indicates activity and direction on 7 lines
- No batteries or power required

T.D. Transmit Data
D.S.R. Data Set Ready
R.D. Receive Data
C.D. Carrier Detect
R.T.S. Request to Send
D.T.R. Data Terminal Ready
C.T.S. Clear to Send

Cat. X15656 .... **Normally $39.95**
SPECIAL, ONLY $32.95

008 335757 TOLL FREE MAILORDER HOTLINE FOR CREDIT CARD ORDERS! LOCAL ORDERS & INQUIRIES CALL (03) 543 7877

ROD IRVING ELECTRONICS HAVE A HUGE RANGE OF DISCOUNT PERIPHERALS



SAMSUNG 12" FLAT SCREEN COMPOSITE MONITOR ONLY $149

FEATURES....
- Flat, high contrast, non-glare screen
- High resolution, 80 or 40 character display
- Tilt/swivel base
- Compatible with Apple* and IBM* colour composite signal

SPECIFICATIONS....
Picture tube: 12" diagonal and 90° deflection
Phosphor: Available in Green or Amber
Video input signal: Composite Signal
Polarity: Negative Sync
Level: 0.5-2.0Vp-p
Impedance: 75ohm
Scanning frequency:
Horizontal: 15.734 KHz + - 0.1%
Vertical: 50-60Hz
Video bandwidth: 20MHz
Active display area: 216(H) x 160(V)mm
Display character: 80 character x 24 rows
Input terminal: RCA Phono Jack
Controls:
Outside: Power Switch, Contrast, Brightness, H-Shift, V-Size
Inside: H-Width, H/V hold, H/V linearity, Focus
Power supply: 110/120V 60Hz 220/240V 50Hz
Dimensions: 310(W) x 307(H) x 300(L)mm
Weight: 8.1 Kg
Shipping weight: 9.6 Kg

Cat.No	Description	Price
X14510	GREEN only	$149
X14512	AMBER only	$149

SAMSUNG 12" 20MHz COMPOSITE MONITOR ONLY $129

FEATURES....
- High contrast, non-glare screen
- High resolution, 80 or 40 character display

SPECIFICATIONS....
Picture tube: 12" diagonal and 90° deflection
Phosphor: Available in Green (P39) or Amber
Video input signal: Composite Signal
Polarity: Negative Sync
Level: 0.5V-2.0Vp-p
Scanning frequency:
Horizontal: 15.734 KHz + - 0.1%
Vertical: 60Hz
Video bandwidth: 20MHz
Active display area: 216(H) x 160(V)mm
Display character: 80 characters x 25 rows
Input terminal: RCA Phono Jack
Controls:
Outside: Power Switch, Contrast, Brightness, H-Shift, V-Size
Inside: H-Width, H/V hold, H/V linearity, Focus
Power supply: 110/120V 60Hz 220/240V 50Hz
Dimensions: 308(W) x 307(H) x 297(L)mm
Weight: 7.3 Kg
Shipping weight: 8.3 Kg

Cat No	Description	Price
X14514	(GREEN)	$129
X14516	(AMBER)	$129

10 OR MORE ONLY $119ea

"NO BRAND" DISKS!!

Now you can buy absolute top quality disks that are also the cheapest in Australia! They even come with a 5 year guarantee, which indicates the quality of these disks. So why pay 2-3 times the price for the same quality?

Packs of 10, D/S D/D without boxes, or brand name, just their white paper jacket, and index labels. (5¼" disks includes write protects).

5¼" D/S "NO BRAND" DISKS FROM $0.80 EACH!!

10+DISKS	100+DISKS	1,000+DISKS
$9·00ea	$8·50ea	$8·00ea

(ALL PRICES PER 10 DISKS. TAX EXEMPT PRICES LESS $1)

3½" D/S D/D "NO BRAND" DISKS!

10+DISKS	100+DISKS	1,000+DISKS
$27	$26	$24

(ALL PRICES PER 10 DISKS. TAX EXEMPT PRICES LESS $2)

VERBATIM DISK SPECIALS!

All prices 10 disk boxes!

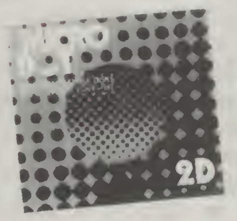
Description	1-9 boxes	10+boxes
3½" 1S/2D	$44.95	$42.95
3½" 2S/2D	$46.95	$43.95
5¼" 1S/2D	$22.00	$21.00
5¼" 2S/2D	$26.00	$24.00
5¼" 2S/4D	$75.00	$70.00
5¼" 2S/HD	$42.95	$41.00

PRICE BREAK THROUGH!

20 M/BYTE HARD DISK
Tandon drive with controller card. IBM* compatible. Warranty
Cat X20010 ...... ONLY $595

40 M/BYTE HARD DISK
Seagate drive. IBM* compatible 12 month warranty
Cat X20020 ...... ONLY $795

80 M/BYTE HARD DISK
Seagate drive. IBM* compatible. 12 month warranty
Cat. X20030 ...... ONLY $2,695



MICRODOT DISKS!

DESCRIPTION	1-9 BOXES	10+ BOXES
3½" 2S/2D	$29.95	$28.95
5¼" 1S/2D	$12.95	$11.95
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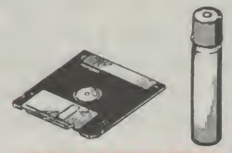

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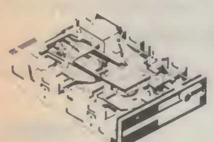

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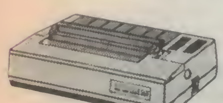

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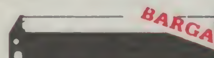

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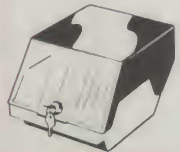

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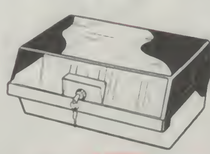

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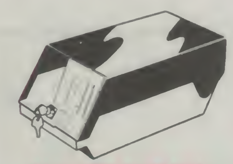

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Audio Amplifiers — 3

Solid-state power amplifiers – class A, AB, B — bipolar and FET

While a few hifi enthusiasts still express a preference for valve technology, most present day amplifiers rely on solid-state devices throughout. There is a vast difference, however, between a modern solid-state power amplifier and the primitive circuits that were used in early transistor portable radios and tape players.

by NEVILLE WILLIAMS

The first generation of transistors to appear on the market were low powered germanium devices that provided designers of battery powered receivers with the breakthrough they had been dreaming about for 40-odd years. The "Transporta 7", the first full scale build-it-yourself transistor portable to be featured in *Electronics Australia*, appeared in the Feb.'59 issue.

The audio system (Fig.1) involved a voltage amplifier, followed by a driver transistor, transformer coupled to an output pair operating in push-pull class-B, with an output transformer feeding the loudspeaker voice coil. Except for a small amount of negative feedback, the configuration followed routine class-B battery valve circuitry.

(In class-B mode, the output devices are so biased that their quiescent anode/collector current is reduced almost to cut-off, with each handling respectively the positive- or negative-going signal excursions. Class-B offers high conversion efficiency, minimising battery or power supply drain and maximising the audio power output available from devices of a given wattage rating).

As larger and more generously rated transistors became available, they found ready application in portable utility amplifiers, as well as in automotive and general purpose domestic receivers. At about the same time, however, public acceptance of stereo was setting the scene for a major up-market move into solid-state hifi systems.

Manufacturers had been able to double the number of channels in valve equipment without doubling the price but there was no escaping the fact that valve technology, with its high power supply and per-socket costs, and its reliance on expensive output transformers, was at a competitive disadvantage.

Further to tip the scales was an emerging market preference for compact loudspeaker systems which, for a given audio bandwidth, were significantly less sensitive than the large 30cm systems of the mono era — all together a powerful incentive to develop solid-state amplifiers capable of economical mass production, good quality sound and higher output power.

It was a challenge which Japanese manufacturers took up to particularly good effect, in their concerted drive to capture the world hifi market.

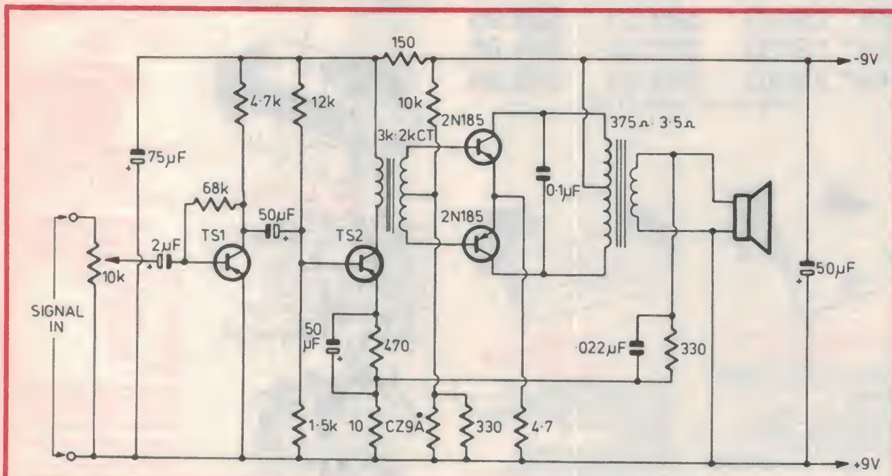

Fig.1: The audio section of the "Transporta-7" radio of February 1959, typical of the early transistor amplifiers which revolutionised battery portable equipment. They also gave transistors a "low/medium-fi" image, which they have since had to live down!

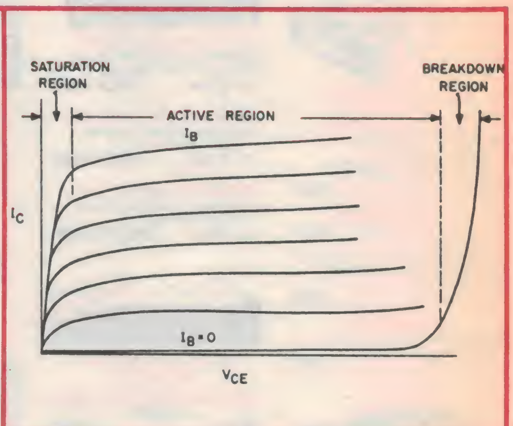

Fig.2: As illustrated above, the collector family of curves for a bipolar transistor resemble those of a thermionic tetrode or pentode. When operating into a loudspeaker load, negative feedback is essential for reasonable sound quality.

Though described as a 60+60 watt amplifier, the Playmaster 60/60 amplifier of July 1986 actually has an IHF (music) power output of double that figure, into 4 ohms. For most listeners, an amplifier like this would be a near ideal choice, combining modern and economical design with outstanding specifications.

Early transistor amplifiers

With an eye to economy and power, the new wave of solid-state hifi amplifiers continued to rely mainly on class-B output stages but, with greater emphasis on fidelity, the designers had to address themselves to design problems not adequately accounted for in the simple transformer-coupled configuration of Fig.1.

For example, the collector current/-voltage curves of a normal bipolar power transistor (Fig.2) strongly resemble the anode family curves of a tetrode or pentode power valve — further complicated by a breakdown region beyond the high voltage end. As a result of this characteristic, and the predominantly high output resistance, bipolar output transistors pose similar design problems to those identified in the last chapter for thermionic pentodes and tetrodes:

- They cannot readily accommodate a complex reactive load, as presented by a loudspeaker, resulting in a potentially high level of distortion.
- The output voltage tends to vary with load impedance, in practice resulting in exaggerated (strident) treble.
- Because of the high output resistance, there is inadequate electrical damping of the bass driver, with the possibility of "boomy" bass.

As with tetrodes and pentodes, it is essential to use a high order of voltage negative feedback around the output stage, if the distortion, frequency response and damping are to meet acceptable hifi standards. In turn, substantial negative feedback calls for considerable care in design, to ensure that the amplifier will remain stable under all likely operating conditions.

Fortuitously, power transistors can operate directly into loads in the 4/16-ohm range, typical of loudspeaker voice coil circuits. This makes it possible to eliminate the output matching transformer, with its cost, bulk and phase-shift problems. But in the process, a completely different circuit configuration becomes necessary to supply the output transistor collectors with voltage and current, independently of the loudspeaker feed. (More about this later).

Having eliminated the output transformer, it makes good sense to get rid of the driver transformer also, thereby severing the final link with the traditional circuitry in Fig.1. From the outset, most hifi equipment designers opted for resistance-fed driver stages, either directly or capacitively coupled.

A further problem that had to be addressed is that bipolar output transistors need to be protected against thermal "runaway". The passage of current through the transistor raises the internal junction temperature which, in turn, makes for an increase in current, thereby further raising the temperature — a regenerative relationship.

The effect is normally counteracted by bolting each output transistor shell to a metal heatsink, either directly or separated by thermally conductive insulating washers. Ideally, the thermal conductivity and dissipation of the heat sinking will be such that a condition of thermal equilibrium is achieved, with the junction temperature unable to reach a level likely to result in device breakdown.

As a further precautionary measure the designer may need to mount certain driver transistors on the same heatsink so that they react to any change in temperature. By using direct interstage coupling, a thermal shift in the operating conditions of a driver transistor can cause it to modify the output stage bias in a way that will oppose the temperature change, thereby creating a degenerative thermal feedback loop.

Temperature problems have figured large in designers' continuing preference for class-B output stages in solid-state amplifiers. Under quiescent or small signal conditions, dissipation within the output transistors is quite small and, even when handling high output, a power conversion efficiency of around 70% means that the dissipation within each device is only about 15% of the mean power being delivered to the load.

High efficiency is normally reflected in the modest proportions of the power supply. While the variation in current drain with signal level demands reasonably good voltage regulation, it poses nothing like the problem that it once did in the case of a high-power B-class amplifier using valves.

Typical early design

The need to take account of the above considerations can result in a variety of circuit arrangements, which may be somewhat bewildering at first encounter. The point behind this is that resistors, capacitors and small-signal transistors cost only cents apiece in a factory situation and take up little extra space on a circuit board. If a designer considers it desirable to do something another way, he will not be deterred by the need to use a few extra components.

To give some idea of what this is all about, we reproduce in Fig.3 the circuit of one channel of a typical solid-state class-B power amplifier, first used in a small PA system described in the Sept.'72 issue of EA. It was developed by Fairchild Australia engineers around a kit of silicon transistors which, at the time, were the subject of a special offer to EA readers.

The same basic circuit was also used in the Playmaster 136 stereo amplifier (Dec.'72, Jan.'73) and the Playmaster 140 4-channel quadraphonic system (Dec.'73-Mar.'74). In Sept/Oct.'74, it

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featured again in the Playmaster 143, this time with provision to accommodate alternative transistor types.

Looking at the circuit (from the Oct.'74 issue) the output devices TR7 and TR6 are a complementary pair comprising a PNP and an NPN transistor connected in series between +21V and –21V supply lines. Being applied to their respective emitters, the voltages are substantially isolated from the loudspeaker feed.

(The expression "complementary pair" signifies that they are of opposite polarity but otherwise matched).

The two collectors are connected together — a feature which allows them to be bolted directly to a common heatsink. This must be insulated from the chassis, however, because it becomes the active feed point to the loudspeaker voice coil(s), the other lead returning to supply earth and chassis. On the assumption that there must be no voltage across the loudspeaker(s) under quiescent conditions, the voltage drop across TR7 and TR6 should be identical. (More about this later)

Directly coupled to the bases of TR7 and TR6 are another complementary pair, the small-signal NPN/PNP transistors TR3 and TR4. These are disposed symmetrically across the supply lines and again must be assumed to be substantially balanced.

Strung between their respective bases is TR5, serving as a so-called "amplified diode". Its role is to provide a signal path between the two bases while, at the same time, injecting a stable differential bias. A 220-ohm potentiometer, associated with TR5 serves to preset the bias levels throughout the direct-coupled network and, ultimately, the quiescent collector current through TR7 and TR8. A link is included in the TR7 collector circuit to facilitate measurement, with the notation "Iq = 12mA".

(The quiescent current should always be set to the recommended figure. Too low a current will aggravate crossover distortion — explained later; too high a current will raise the mean temperature of the output transistors and may also increase the distortion because of undue overlap in the dynamic curve).

The constructional article stresses that TR7 and TR6 must make intimate electrical and thermal contact with the heatsink by careful fitting and the use of silicone grease. To provide thermal feedback, as mentioned earlier, TR5, TR3 and TR4 must also make thermal contact with the heatsink by the provision of dimples or clearance holes, as necessary, and generous blobs of silicone grease.

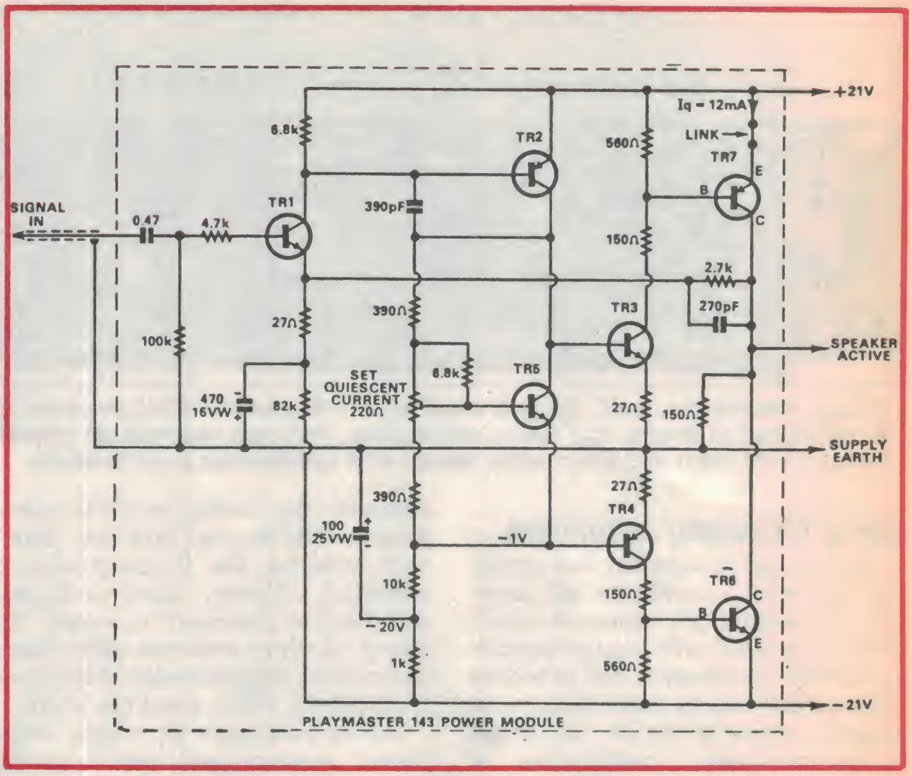

Fig.3: Reprinted from the Oct.'74 issue EA, this circuit was used in several projects about that time. Its operation and design philosophy are explained in the text.

How it all works out

TR2 is a high-gain pre-driver which feeds signal directly to the base of TR3 and through TR5 to the base of TR4. At this point, a simple exercise should serve to show how this kind of circuit functions.

A negative-going signal at the base of TR2 would increase the current and generate a positive-going signal at the collector, and therefore at the bases of both TR3 and TR4.

A positive-going signal to the NPN TR3 would produce a negative-going signal at its collector, and at the base of the PNP TR7. This would increase its collector current, so that it "falls" away from its negative supply and towards the positive emitter. The result: the speaker voice coil receives a positive-going drive signal.

Go through the same exercise with the same positive-going input to TR4 and you will find that, when the current through TR7 is peaking, the current through TR6 is cycling through cut-off, thereby allowing the loudspeaker to react to the drive from TR7.

On the opposite half-cycle, the situation is reversed with TR7 cycling through cut-off and TR6 supplying a negative drive to the loudspeaker. As far as the loudspeaker is concerned, the end result is precisely the same as if it was being driven by a conventional class-B transformer-coupled stage.

A couple of other details and Fig.2 will have served its purpose:

The NPN transistor ahead of the pre-driver is a low-noise type, again directly coupled but operating across the full available 42V supply. Negative feedback from the loudspeaker drive to its emitter serves most obviously to correct the shortcomings of the bipolar output transistors, as listed earlier, along with other possible noise and distortion products occurring within the feedback loop.

But it also serves another purpose: The base of TR1 is referenced to earth potential by a 100k return resistor. If the emitter of TR1, reacting to the feedback, was to move more than a fraction of a volt from the normal operating bias, the resulting change in collector current and potential would react through the entire DC-coupled network to oppose the shift. In effect, the feedback loop serves also to reference or lock the output transistor collectors and the loudspeaker feed to the gate potential of TR1 — in short, to earth — thereby protecting them from a DC

drive component.

(Ideally, the open-circuit voltage across the loudspeaker feedpoints, the so-called "offset" voltage, should be zero).

Finally, the 390pF capacitor between the base and emitter of TR2 and the 270pF capacitor across the 2.7k feedback resistor serve to control phase shifts within the feedback loop and ensure stability under all likely operating conditions.

Depending largely on the regulation of the power transformer, the output power available from this amplifier was 15-17W RMS, at about 0.6% distortion. Frequency response and power bandwidth were flat over the audio range with –3dB points at 12Hz and 100kHz. Effective output impedance was about 0.1 ohm, giving a nominal damping of 80 with an 8-ohm loudspeaker. The square-wave response was excellent.

While the foregoing description does not by any means cover the many options open to the designer of a class-B bipolar power amplifier, it should at least give the reader some insight into the broad concepts and the performance of solid-state hifi amplifiers in the particular period.

Later refinements

Since then, the performance of typical class-B bipolar amplifiers has been systematically upgraded, with the rated power output boosted from the 15-odd watts per channel RMS, equating to valve practice, to progressively higher figures. EA hifi homebuilders were offered the "Twin-25" stereo amplifier in April-June 1976 and the "Forty-Forty" in Dec.'76 and Jan.'77. For those with access to the above issues, the respective articles provide a natural follow-up to the circuit of Fig.3.

In both the "Twin-25" and the "Forty-Forty", the rated distortion at full power was reduced by more then 2:1, falling to below 0.1% at normal listening levels. A special LCR compensation filter in the loudspeaker feed circuit guaranteed "unconditional" stability under any load condition, serving also to block penetration by stray RF signals picked up by long loudspeaker leads.

A new C-core power transformer, sufficiently compact to replace the earlier conventional type, provided the extra voltage and current required for the "Forty-Forty" version. As a bonus, it offered a reduced hum field, with less chance of hum injection into adjacent signal sources.

In the May-July '86 issues, the sequence of do-it-yourself bipolar amplifiers culminated in the highly refined "Playmaster 60/60" (Fig.4) offering an RMS output per channel of 62W (8 ohms) or 72W (4 ohms), both channels driven. IHF ("music") power was 95W and 120W respectively. Measured THD for the above ratings was down around around 0.01%, while the effective signal/noise ratio measured 103dB for the line inputs and 89dB for the phono channel.

In deference to the large available power output, the design incorporates automatic protection for the loudspeakers against switching pulses and inadvertent overload. Again, the descriptive articles would provide helpful back-up reading to this present chapter.

A point stressed in the articles is the importance of layout, and the need to ensure that spurious noise and distortion components are not radiated or fed into low level signal circuits by proximity or common paths. Without due attention to this, the distortion and noise figures quoted above would simply not be attainable.

Doubts about class-B

Reassuring as the figures may be nowadays, there was a period in the mid/late '70s when hifi enthusiasts began to question the "sweetness" or "musicality" of transistor sound. While often dismissed as pure imagination, it was alternatively suggested that the complaints might have something to do with class-B operation — a mode that was confined largely in valve technology

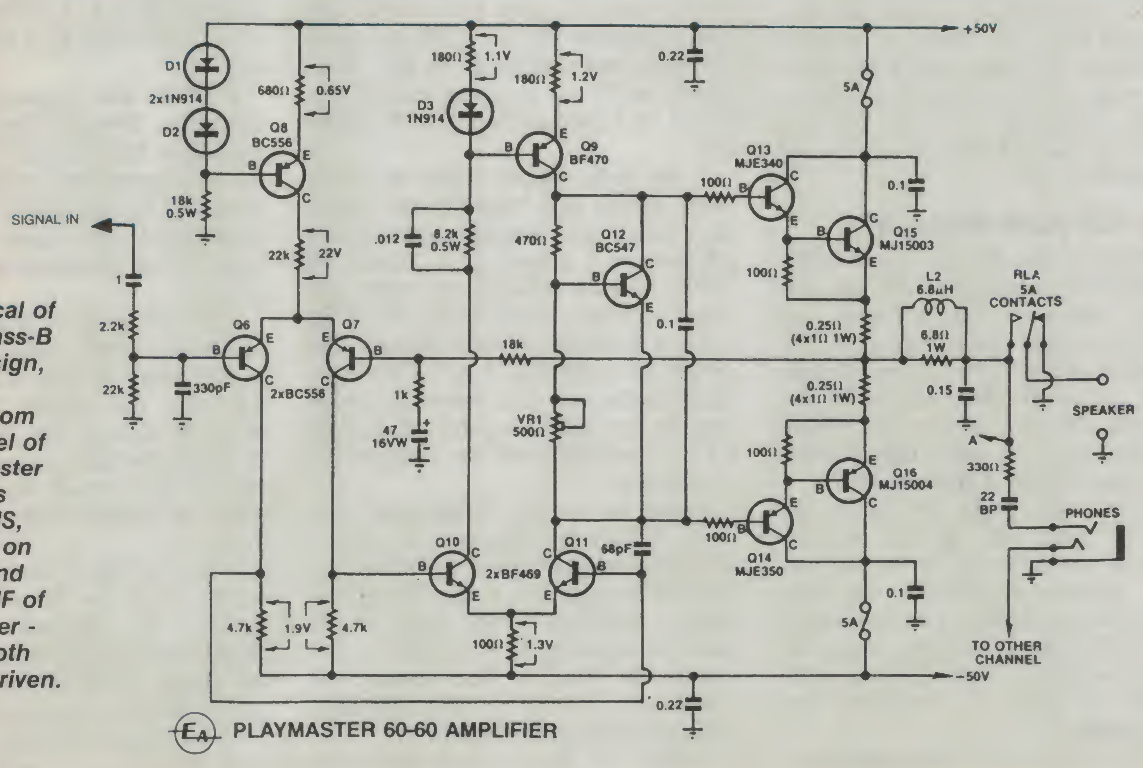

Fig.4: Typical of modern class-B bipolar design, the power amplifier from one channel of the Playmaster 60/60 offers 62-72W RMS, depending on the load, and 95-120W IHF of music power - this with both channels driven.

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to battery receivers and public address equipment!

A basic requirement with class-B amplifiers is that the output devices be so biased that each is drawing a small, specified current under quiescent conditions, such that the signal to be amplified can transfer smoothly from one device to the other for each alternate half-cycle. However, if there is a kink in the combined characteristic (Fig.5) there will also be a kink in the output waveform, described as "crossover" distortion.

Measured as a THD (total harmonic distortion) percentage at full output, crossover distortion may appear to be insignificant; but the percentage relative to small signals — e.g. soft musical passages — can be muchlarger, and therefore consistent with complaints that solid-state amplifiers sounded fine on loud music but "coarse" in the softer passages.

The counter argument was that careful adjustment of the quiescent current (Iq = 12mA in the case of Fig.2) should virtually obviate the problem, leaving any residual distortion to be dealt with by the negative feedback — an assumption that relies on the long-term stability of the bias adjustment.

Further to complicate matters, it was also pointed out that flattening of the dynamic characteristic would not only put a kink in the waveform but it would also reduce the gain around the feedback loop in the crossover region, thereby rendering it less effective against any non-linearity at all at that point in the cycle!

Why not pure class-A?

Justified or not, the anti-class-B lobby clamoured for a return to the time honoured push-pull class-A mode, in which the output devices are biased to the centre of their own dynamic characteristic and never driven beyond its linear limits. The two devices complement each other over the entire output cycle, minimising distortion in the process.

It sounds fine except that the devices draw the same total current, whether quiescent or delivering power. In fact, under quiescent conditions, the total input power is dissipated in the devices and, even when delivering maximum undistorted output, only about one third of the DC power is converted into audio output.

What is more, since the supply current remains constant under all conditions, there can be no supply voltage build-up during low-level passages and therefore no resulting voltage "headroom" to accommodate isolated program peaks. RMS power is all there is!

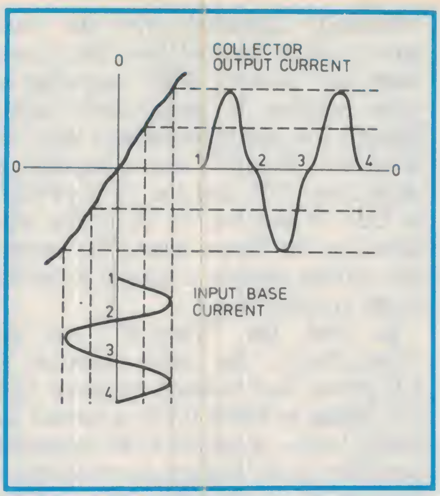


Fig.5: If the separate dynamic curves for a class-B amplifier have a kink or discontinuity at the centre, the output waveform (top right) will be similarly malformed, or distorted.

Class-A was all very well in the valve era, when enthusiasts were satisfied with 15-odd watts driving a large and sensitive 30cm loudspeaker. It didn't matter a great deal if the power required from the mains was six or seven times the RMS output; it was still only around 100W.

But a very different answer emerges if one does the sums for a solid-state stereo amplifier for the 120W per channel music power delivered by the "Playmaster 60/60" — a typical enough example of a modern hifi class-B amplifier.

If the total output power is to be 240W (RMS and "music") the power input for class-A, assuming a conversion efficiency of around 33%, would be 720W, without allowing for other circuitry or power supply losses. Even filtering it would be problem enough. The output devices would have to be capable of coping with that amount of power and the heatsink(s) capable of dissipating it — probably with the assistance of a cooling fan.

Facing up to the commercial challenge of class-A in the mid '70s, Technics (Matsushita) engineers claimed that the power supply for a true 120+120W class-A amplifier would have to be rated at anything up to 1.4kW — not exactly the kind of heat source one would welcome in the listening room during an Australian summer!

Despite all that, a few solid-state, pure class-A amplifiers have been produced over the years — but without ever circumventing the fundamental constraints of inadequate power output or dauntingly high bulk, mass, temperature and cost.

Other approaches?

Technics' initial answer to the dilemma was to come up with their "class-A+" system, as announced in the Dec.'77 issue of EA. It was said to combine the tonal purity of class-A with the efficiency of class-B — an apparent self-contradiction. But there had to be something special about it, because its rated output was 350+350W per channel into 4 ohms, with a THD of 0.003% at full power and "unmeasurable" at half power.

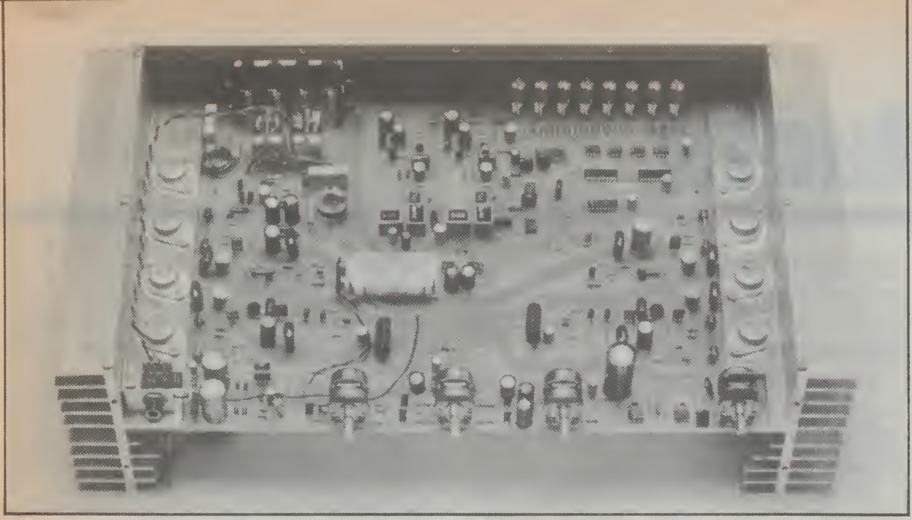
It transpired that the design involved a low-power class-A output stage and a high-power class-B stage, working together virtually in tandem. In the immediate vicinity of the cross-over point, the signal was handled by the class-A stage. Beyond what we judged to be about 1-watt, the class-B stage took over, the unusually husky class-A transistors becoming little more than a conductive path for the external drive current. (See EA, Feb.'78).

In Britain, QUAD had come up with their so-called "current dumping" concept, which also used the dual output concept but operating more in parallel than in series. (See EA for Jan.'76).A small amplifier by comparison with the Technics SE-A1, it nevertheless offered 100+100W RMS at a full power THD of 0.1%.

Technics had originally intended to produce a complete range of class-A+ amplifiers but decided that they may not be commercially viable. Convinced, however, by the magic of the class-A connotation, they came up with "New Class-A" as discussed in the June '80 issue.

It proved to be an exercise in semantics rather than technology. A basic characteristic of class-A, they insisted, was that the output devices should never be driven into cut-off. So they modified the drive circuit of what was essentially a class-B bipolar power amplifier to include high-speed switching diodes.

Voila! As the drive signal swept towards cut-off for the respective output devices, the particular series diode would interrupt the drive signal, leaving the output device to idle very close to cut-off without ever going beyond it. Technics engineers were adamant that their "New Class-A" with its "synchro-bias" circuitry was more precise and



The internal "works" of the Series-200 Playmaster, with the signal circuits accommodated on two main circuit boards. Note especially the large heat sinks carrying the two rows of power FETS. The power supply, not shown, uses a special low-profile toroidal power transformer.

stable than the conventional class-B system.

Perhaps it was, because their SU-V4 and SU-V8 models announced at the time were impressive, with the latter offering 140+140W RMS, or 160+160W IHF into 4 ohms, with a full-power THD of less than 0.01%.

Other techniques publicised from time to time have included sliding or dynamic bias, which is dependent on the average signal level, such that the output stage operates in class-AB for small signals and full class-B for higher outputs.

The ultimate in dynamically modified operating conditions, however, has been demonstrated in the Carver series of amplifiers in which the power supply is effectively modulated by the incoming audio. At all times, the power drawn from the mains — and therefore the heat generated — is only as needed to cope with the required audio power envelope, the end result being that very high program levels can be realised from an agreeably compact and cool-running unit. The principle is discussed in the Sept,'87 issue of EA, although proceeding to the conclusion that the model under review, while impressive, is not necessarily an automatic choice for a domestic hifi system.

FET-based amplifiers

What did catch the attention of hifi enthusiasts was an announcement in the technical press (EA Mar.'75) that successful power FETs (field effect transistors) had been developed by Professor Nishizawa of Tokatu University in Japan, under commission from Yamaha; and that parallel research had been undertaken by Trio, Kenwood, Matsushita, Sony and Pioneer.

It was claimed that, unlike bipolar transistors, the new power FETs were not prone to thermal runaway and were more suitable for class AB operation. Like valves, they responded to voltage rather than current signal drive and were roughly equivalent to sixteen 2A3 valves in parallel push-pull class AB1. A chunky developmental Yamaha amplifier, pictured in the issue, was said to offer 150+150W RMS at 0.1% THD, falling to 0.04% at 1W.

A further article in the May '75 issue explained the principles in some detail, mentioning the development of prototype FET amplifiers by other manufacturers and picturing Sony's TA-8650, rated at 80+80W RMS into 8 ohms for a THD of less than 0.1% at rated output. To the anti-solid-state and anti-class-B lobby, power FETS sounded like the perfect compromise.

The fact remains, however, that with its lower conversion efficiency, class AB operation demands larger and more costly devices, heat sinks and power supplies, putting FET amplifiers at a price disadvantage and tending to push them up-market into the more pretentious designs.

Typical of such amplifiers is the "Series 200" described for home construction in EA for Jan, Mar, and May '85. Very much a state of the art design, it offers up to 160+160W RMS into 4 ohms for a THD of less than 0.03% for full output, with other performance figures to match. It could be central to any group of top-of-the-line peripherals but the fact remains that, as a kit, it costs about twice as much as the "Sixty-Sixty".

Some would consider the extra money well spent; most would listen in vain for any subjective difference. That's what hifi argument is all about!

(To be continued)

New Products

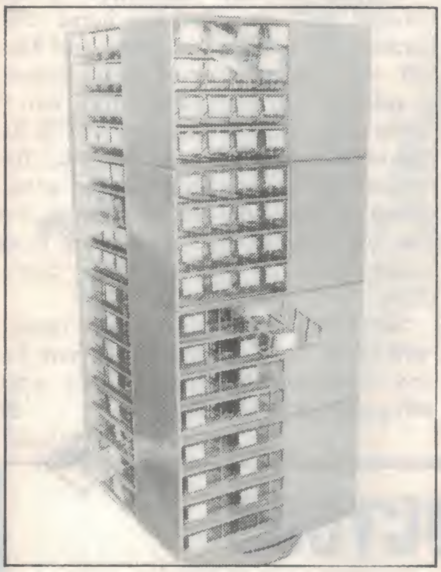
High temperature electrolytics

Cornell Dubilier Components has expanded its electrolytic capacitor range with subminiature series 226 (radial) and 201 (axial), which are designed for applications requiring long life and high temperature ranges.

The extended temerpature range of 150° (221°F), low leakage current and small size make them ideal for circuits where high stability is a premium.

Available in a capacitance range from 0.1uF to 10,000mF and a voltage selection from 5.3V to 250V, these capacitors are supplied in 15 can sizes ranging from 5×11mm to 18×40mm.

Free catalogs and further information are available from Crusader Electronic Components, 81 Princes Highway, St. Peters 2044.



Small parts storage system

The Treston range of small parts storage equipment is claimed to be the most comprehensive available from any one manufacturer in Australia.

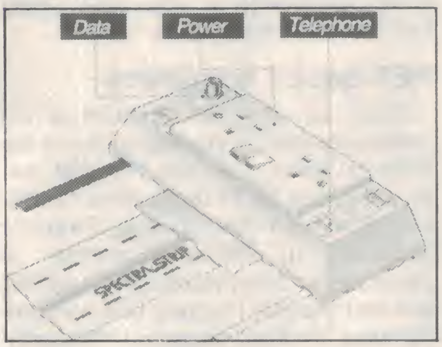
The range covers the usual picking and stacking bins and then extends into a wide range of visible storage cabinets. These cabinets can then be included into a 'Treston Carousel'. The most popular carousel consists of three layers of four visible storage cabinets.

Each cabinet has external dimensions of 540×300×160mm deep. There are nine different drawer sizes available, with either longitudinal or latitudinal dividers available that actually lock into place – preventing small part migration from one compartment to the next.

Even with a basic system it is possible to store up to 4320 part numbers (up to 1000kg) in a mere quarter square metre of floor space.

As well as the individual storage cabinets and carousel units, Treston also offers a wide range of plastic picking and stacking bins. Also storage cabinets, carousels, picking and stacking bins all in conductive/antistatic material. This particular range has proved very successful in the electronics industry.

For further information about the Treston storage solution please contact Matson Automotive Industries at 15-17 Beresford Avenue, Greenacre 2190 or phone (02) 708 4300.



Undercarpet cables

The Spectra-Strip undercarpet cable system is designed, developed and manufactured in the UK. The system offers a more flexible approach to office wiring for new buildings and office refurbishment, with a range of flat cables and outlets to implement a network of pedestal units conveying telecom, data signals and electrical power as required in the modern office.

The flat-cable system is seen as a complement to the conventional skirting trunking system, bringing a new freedom in office layout. In the smaller office it is possible to site equipment near supply sockets, but this is not practical in large, open-plan offices. The simple solution of laying flat cable onto the floor, terminating it to existing outlets and covering it with carpet tiles, offers a new flexibility.

Further details from Amtron Australia, 176 Cope Street, Waterloo 2017.

PCB relays

AP Imports introduces Elesta's comprehensive range of PCB relays in the SGR series.

High safety standards are achieved through exceptional separation of control and load circuits, and Elesta's innovative design ensures top reliability with the relay coil moulded-in complete. Dimensions of no more than 30×25×12.5mm, creeping distances and air gaps exceeding 14mm are obtained, meeting the safety rules VDE0631/0730. Test voltage between coil and contact set is 5000V RMS.

SGR PCB relays are monoliths. The solenoid circuit with coil and the contact spring with all connecting parts are moulded-in, complete with glass-fibre-reinforced polyamide. This means adjustment remains unchanged even after bending the PCB connections. The relays also withstand soldering baths, the sealed base allowing machine soldering.

Rinsing and lacquering can be carried out without risk – Elesta's low cost O-ring will keep out flux and cleaning agents. The sealed version is recommended for applications of high security such as PCB cleaning with pressurised water.

Further details from AP Imports, 41 Box Road, Crossroads 2170.

EPROM programmer

The MA1000 EPROM programmer from Microcontrol programs virtually all 24, 28 and 32-pin MOS/CMOS (E)EPROMs up to 1M bit 27010/27011, without any personality modules. It is claimed to be the first Australian designed and made programmer capable of programming 1Mb EPROMS. An expansion bus is provided to accommodate adapters for less common and future programmable devices.

All programmer software is contained on-board and the unit is programmed

via an RS-232C interface. Software updating is done simply by replacing the control program PROM.

Transmission rates of up to 19,200bps are available with optional XON/XOFF software handshake. Eight translation formats are supported including Intel, Motorola, Tektronix, ASCII and binary allowing the MA1000 to interface with most development systems and PCs.

The programmer supports standard, intelligent and superfast programming algorithms like Intel Quick-Pulse.

The programmer split mode supports 16 and 32-bit systems allowing the data to be split into multiple EPROMs. A 128Kbyte (1Mbit) static RAM buffer is included. A non-volative buffer may be supplied as an option.

Further information is available from Microcontrol, PO Box 30, Kogarah 2217. Phone (02) 588 1774.

800cps impact printer

The Seikosha SBP-10AI is an impact printer with 18-pin dot matrix head, designed for heavy duty business use. It provides 800cps in draft mode (250 lines/minute), 400cps in correspondence mode and 200cps in NLQ mode.

Other features include two resident character fonts, 256 downloadable characters, resident enlarged printing capability up to 10×10 (VxH), provision for up to 4 font cartridges, 64K print buffer, a dual Centronics/RS-232C interface and emulation for both IBM Proprinter and Epson ESC/P.

The SBP-10AI has a push-pull tractor feed, automatic paper loading/ejection, and standard cartridge-type cut sheet feeder with optional second tray.

Print head life is quoted at 300 million characters, with a ribbon life of 20 million characters.

Further information from AWA Measurement and Control, Unit C, 8 Lyon Park Road, North Ryde 2113.

PCB hardware

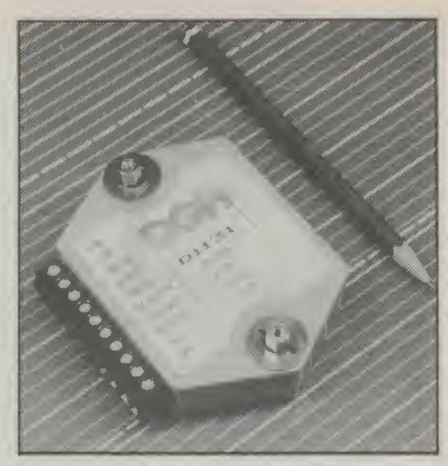
PSM Fasteners offers a range of products for the electronics and sheet metal industries, in Australia. Some of the products carried and serviced include:

- Serrated anchor rivet brushes
- Swift thread self-clinching captive fasteners
- Self broaching fasteners for PCBs
- Nylon support posts for PCBs
- Threaded spacers and support pillars
- Tri-lobe blind fitting captive nuts
- Blanc-lok push-in blind fasteners

PSM can also supply a large range of plastic and nylon fasteners and fittings, with a 4-6 week lead time.

A comprehensive 44 page brochure is available on request.

For further information contact PSM Fasteners at 287-289 Trafalgar Street, Petersham 2049, or Level 9, 608 St Kilda Road, Melbourne 3004. Phone (02) 560 7266.



Sensor interface module

Data Electronics has released the DGH D1000 and D2000 series of Sensor to Computer Interface Modules, which allow analog and digital sensors to be interfaced to personal computers and microprocessor based control equipment. The modules have wide application in both research and industrial monitoring and control, allowing distributed remote data acquisition and configuration of task specific data loggers.

Communications is via an RS232C or RS485 serial interface, and up to 124 modules can be networked to a single host computer port either directly or via modems. Converters are available to convert RS232C and RS422 communications standards to the RS485 standard.

For further information contact Data Electronics (Aust) Pty Ltd, 46 Wadhurst Drive, Boronia, Telephone (03) 221 1277.

New Products

Low-cost AT compatible

The Tandy 1000 TX personal computer uses Intel's 8MHz 80286 microprocessor and runs three times faster than the new IBM PS/2 Model 30 computer and six times faster than a standard PC/XT. Although priced at only $2,299, it provides processing power previously found only in 'AT' class machines.

The latest in 8.9cm (3½") disk technology, coupled with seven custom designed ASIC chips, is claimed by Tandy to position the 1000 TX personal computer in the forefront of engineering design and quality.

The 1000TX is supplied with MS-DOS 3.2 operating system, GW-BASIC and Personal Deskmate 2 software.

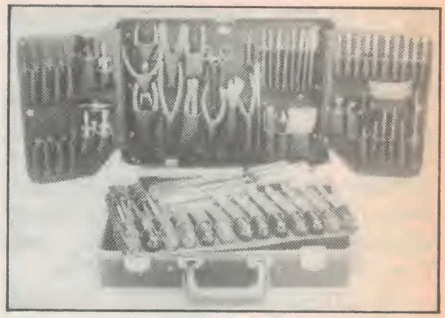
Standard hardware features include a parallel printer port, RS-232S serial port, two joy-stick ports, three-voice sound and headphone jack with volume control.

The 1000 TX (Cat No. 25-1600) is available through more than 360 Tandy Stores, Tandy Computer Centres, Tandy Computer Departments and participating dealers nationwide.

Metric tool cases

Specialist technician Xcelite tool cases are now available with metric tools. Manufactured by Cooper Tools in the USA, Xcelite tools have set standards of performance and quality for the electronics, office equipment and related user industries.

The Xcelite metric tool cases are to be known as the TC100ME, TC150ME and TC200ME. All are attache-style tool cases with a selected range of screwdrivers, nutdrivers, 99-Series interchangeable bits and handles, tweezers, miniature pliers and other products. All



cases have provision for further tools, specific to the user's need.

Xcelite tool cases are available through electronic, industrial, office and computer equipment suppliers. For complete details, contact Cooper Tools, PO Box 366, Albury 2640. Phone (060) 21 5511.

Bar code reader for MAC, SE, MAC II

Nortronic Instruments is proud to announce the immediate availability of the Databar Model 440 bar code reader for the Apple Desktop Bus, making it suitable for use on the Macintosh SE and Macintosh II.

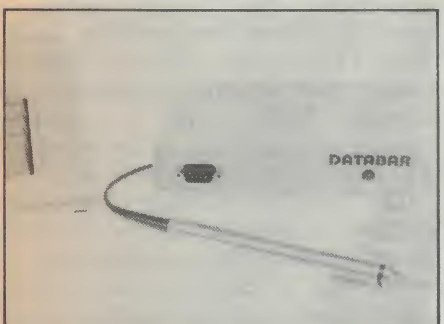
Connection to the Mac is simply a plug into any free bus socket on the system unit, keyboard or other input de-

vice. The reader is completely transparent to the applications program, as the Mac thinks that data are coming from the keyboard.

The reader will automatically read all commonly used bar codes. The terminator may be set to Return, Tab or no terminator by a switch setting. It comes with a high resolution wand and a cable to attach to the Mac. No power supply is needed, as the reader is powered by the Mac.

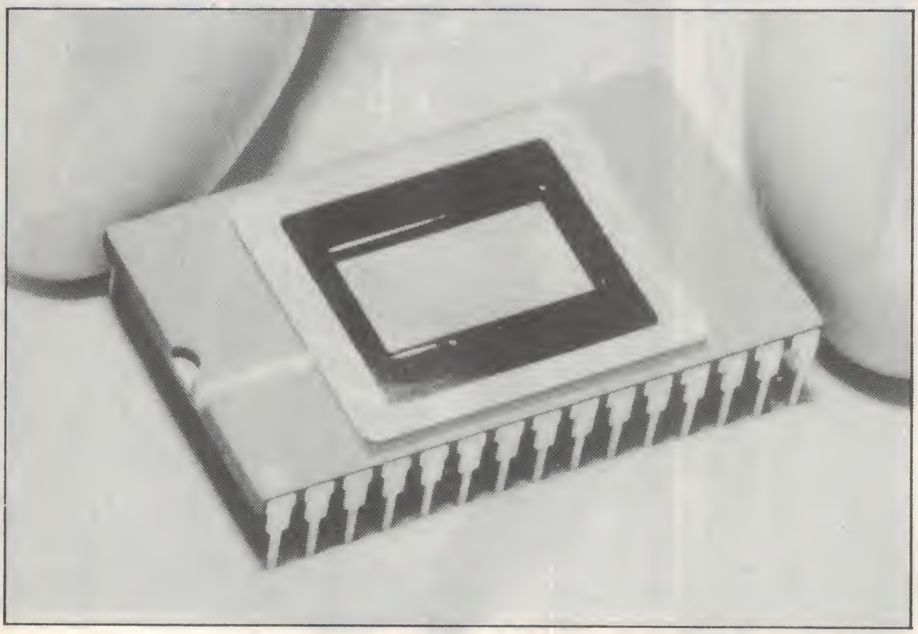
The reader is priced at $895 plus tax if applicable. OEM and dealer discounts are available. The Databar 440 Reader is manufactured in Australia and is available from stock.

For further information, contact Nortronic Instruments, PO Box 300, Brookvale 2100. Phone (02) 938 4994. EA



Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY



Toshiba develops CCD image sensor with 2M pixels

Toshiba Corporation has developed a CCD area image sensor that features as many as 2 million pixels or picture elements (1920H x 1036V) and is suitable for super high-resolution cameras for high-definition TV (HDTV), the next-generation television system with very high resolution.

Today, CCD image sensors are widely used as 'electronic eyes' for home-use video equipment such as VHS-C camcorders and 8mm portable VCRs. CCD image sensors now used in home-use camcorders have 300,000 to 400,000 pixels on a chip, however 2 million pixels are required to realise HDTV.

In accordance with the increase in the number of pixels, the size of each pixel gets smaller. However, when the size of a pixel gets smaller, the size of the area that accepts the light to be converted into electric signals also becomes smaller. This causes the problem of decreased sensitivity or dynamic range of the devices. Therefore, using conventional methods for fabricating CCD image sensors (interline transfer CCDs), it is impossible to realise image sensors with over 2 million pixels.

Toshiba succeeded in developing a 2 million pixel sensor by overlaying a new additional layer on a conventional CCD structure. This new layer is made of amorphous silicon (a-Si) which acts as a sensing area as well as converts the optical information to electric signals. This realised an aperture ratio (percentage of the sensing area which occupies the surface of each pixel) of 100%, resulting in a highly sensitive image sensor.

The absolute sensitivity is 4 or 5 times higher than that of conventional image sensors using interline transfer CCDs, Toshiba has succeeded in increasing sensitivity to 210nA per lux, while integrating 2 million pixels on a 16.2mm x 10.5mm chip using 1-micron microlithographic technology.

In addition, Toshiba introduced a zigzag shaped configuration of vertical-CCD area for signal electron transfer, which makes the width of vertical-CCD much wider than conventional ones and increased the number of electrons to be transferred. This results in a higher dynamic range (range of brightness which can create images with acceptable contrast) of 72dB.

Toshiba also introduced a double horizontal-CCD registers method to meet with the very high read-out frequency of 74.25MHz. The horizontal picture signals from each pixel are alternately read out by two horizontal-CCD registers each driven by a 37.125MHz read-out frequency.

Low-C transient suppressor

General Semiconductor's new low cost, low capacitance SAC TransZorb Series silicon transient voltage suppressor is specifically designed to provide data or signal lines with board-level protection from the devastating effects of electrostatic discharge (ESD) and electromagnetic pulse (EMP).

For use in both commercial and industrial applications, the series offers substantial pricing, size and capacitance advantages. The devices employ a standard General Semiconductor TransZorb TVS in series with a rectifier to reduce the effective capacitance up through 70MHz with a minimum amount of signal loss or deformation. The capacitance is less than 50pF.

The TransZorb transient voltage suppressors are characterised by their high surge capability, their extremely fast response time of less than 5 nanoseconds, and their low on-state impedance. If bidirectional transient protection is needed for AC protection, two of these devices may be used in parallel and opposite in polarity.

The SAC Series features 500 watts peak pulse power dissipation during a one millisecond pulse, with a maximum reverse current leakage of 5uA to 300uA, depending on model. Breakdown voltages range from 5V to 50V.

Further information from ESD, 17 Russell Street, Essendon 3040.

Many advanced chips shown at ISSCC

Hundreds of the semiconductor industry's leading engineers and other technical experts gathered in San Francisco for the annual International Solid State Conference. Amidst an avalanche of more than 100 technical papers, several major breakthroughs were announced including:

- 16 Megabit DRAMs: Hitachi, Toshiba and Matsushita showed off their designs of experimental prototypes of 16 megabit DRAM chips which they hope will become widely available in the early 1990s after the current 1-megabit and forthcoming generations of memory chips will have run their course.
- Faster DRAM: IBM unveiled details of what it claims to be the fastest DRAM memory chips ever developed. The experimental device is capable of retrieving bits of data in just 20 picoseconds, three times faster than the current fastest DRAM chips available.

IBM also claimed to have set a new record in Static RAM technology, with an experimental 144K SRAM chip that will retrieve data in just 11 picoseconds. IBM also showed off a 1 megabit SRAM based on what it claims are the smallest 6-cell transistors ever built.

General Electric detailed the designs of a 32-bit microprocessor that operates at a speed of 40 million instructions per second, more than twice the speed of today's state-of-the-art RISC processors, such as the AM29000 from AMD (17 MIPS).

LSI Logic also impressed many conference visitors with its 30 MFLOP custom microprocessor. At this performance level, the LSI processor falls in the mini-supercomputer-on-a-chip category.

Although it doesn't have a RISC-based processor on the market yet, Intel took a major step towards that objective with the introduction of a 'register scoreboard mechanism', considered an essential technology in the development of RISC processors.

Perhaps the fastest 32-bit RISC processor ever was demonstrated by Control Data and Texas Instruments. TI said the device, when put into production, is expected to operate at a 100MHz clock speed (1000 MIPS), with an eventual goal of reaching a performance level of no less than 200 MIPS by the end of 1989. A true supercomputer-on-a-chip which may one day power highly advanced complex, yet compact defence systems, such as those envisioned in President Reagan's Star Wars defence program.

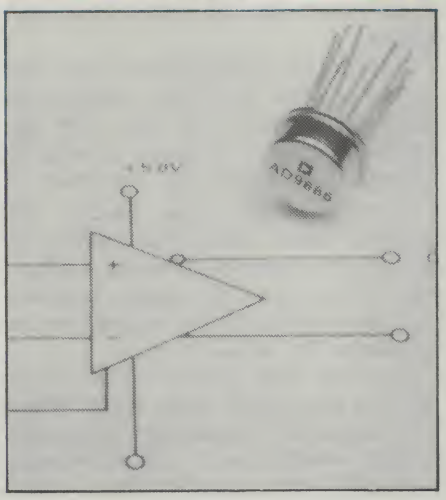
For the production of the chip, TI is using a high-performance 2-micron bipolar HIIL, (heterojunction-integrated injection logic) process. The chip is based on the so-called MIPS (microprocessor - without - interlocked - pipe - stages core instruction set architecture which was developed by DARPA, the Pentagon's advanced technology development group.

High-speed TTL comparator

A new TTL comparator with only 7ns propagation delay and industry-standard pinout has been introduced by Analog Devices. In addition to complementary TTL outputs, the AD9686 provides a latch-enable control line – with 2ns set up time – for very high-speed voltage comparisons.

With the capability to detect high-speed voltage transitions in both analog and digital systems, the AD9686 can be used in input range detection, high-speed analog and digital signal measurement, automatic test equipment, data communications, radar, electronic warfare and missile guidance. Specific applications include crystal- and RC-controlled TTL clocks, window comparators, peak and threshold detectors, and high-speed triggers and line receivers.

In addition to high speed, the new comparator features maximum input offset voltage of only 2mV which typically drifts less than 10μV/°C over both



the commercial and military temperature ranges. Other key specifications include 4μA input bias current and 85dB common-mode rejection ratio.

Further information from Parameters, 25-27 Paul Street North, North Ryde 2113.

Information centre

Quad op-amp chip

I have recently been working on a design that employs four 741 operational amps, and was going to use a 1458 dual amp package. But due to PC board space limitation decided to use a 741 quad package.

I found one of your advertisers could supply a LM348 stated as 4 x 741. On purchase the chip was marked 048DP, on phoning them back they have no information on either.

I have since looked through back copies of EA, tried all electronics chips in Brisbane and even tried the City technical library, but cannot find data and pinouts for this. Can you possibly give me any information? Even pinouts only for LM3487 would do, as I have 741 data. (C.E., Inala, Qld)

• ***The LM348 has the same pinout as the LM342 and TL074 quad op-amps. These are:***

1: OUT 1	*6: IN 2−*	*11: V+*
2: IN 1−	*7: OUT 2*	*12: IN 4+*
3: IN 1+	*8: IN 3−*	*13: IN 4−*
4: V−	*9: IN 3+*	*14: OUT 4*
5: IN 2+	*10: OUT 3*	

Active crossover system

I am in the process of constructing a three band hifi system based on EA's active crossover system in the November 1984 issue. I do not intend to include all the switching but to settle on one crossover frequency for each band.

I have two separate stereo amps for the high and mid bands, approximately 25W+25W. I was considering using the sub-woofer amp of July 1982 (without the low pass filter circuit) or a similar powered amp for the low band and using the sub-woofer speaker system of August 1982. For the high band I would use a Philips dome tweeter AD 11610/18.

For the low band I would like a crossover frequency of approximately 250Hz. As the lowest frequency of the active crossover is 500Hz, would doubling the value of resistors in switch position 1 of switch No.4 achieve this frequency? The mid band frequency would be 250-400Hz. For this band I would have to use a speaker with its resonant frequency below 250Hz. Could you suggest a suitable speaker for this one that is reasonably priced? The high band would be from 4000Hz up. Your comments on these projects would be appreciated. (L.E.H., Toowoomba, Qld).

• ***Your proposed actively crossed-over amplifier and speaker system should work quite well. The advantage of running the mid-range speaker down to 250Hz is that most vocal program content will be handled by this speaker, and will not be interfered with by a crossover point.***

However, you may have to consider a slightly higher powered amplifier (than 25+25W) for the mid range. The wider mid range will place much more of the program load on the speaker/amp combination. Also (as you have pointed out), the speaker should have a resonance below 250Hz.

The ideal speaker for this situation is the bass driver from a good 2-way speaker system. The Philips AD80B52 would do the job for example, although it is a little 'rough' around the 4kHz area.

PA system feedback

I have been a regular reader of EA for the past 45 years, and have read your articles on PA equipment. I have been interested in sound reinforcement all that time, having built and operated my own and other amplifiers during that period.

From all the information I have read on the subject and from practical experience, constant vigilance with the volume control is necessary in order to operate just below the threshold of acoustic feedback, and achieve the greatest volume level. This applies to indoor performances especially – allowing for variations of building acoustics and the position of the microphone in relation to the speakers, etc.

However, what appears to me to be the best kept trade secret is the ability of commercial PA equipment to operate at high volume levels without acoustic feedback. I have heard and seen artists using a mike directly in front of the speakers, not with the volume down but turned up to ear shattering level and without the slightest trace of feedback. How is this possible?

On making some enquiries, I am told to use a very expensive mike, but I do not go along with that – although it does help.

Another suggestion was to use a graphic equaliser – but as I have never used one, I query your opinion as to this being the complete answer. And if so, how and where are they connected in the circuit?

Is frequency shift in the amplifier the answer? I would greatly appreciate your answer to this question.

Are there any publications covering this subject? (M.R.D., Brim, Vic.)

• ***Acoustic feedback in PA systems is a problem for all operators. There are many factors involved in reducing the effect. Most professional operators rely heavily on the careful adjustment of 1/3 octave graphic equalisers, on both the main and monitoring speaker systems. These tend to be connected just before the power amplifiers. The idea is to flatten the overall system response, cancelling out any peaks due to speaker, or mike resonances, and this certainly does provide a worthwhile improvement.***

Expensive microphones definitely have a more elaborate mechanical-acoustic design directed at eliminating feedback. However, this will not help without proper handling techniques by the vocalist.

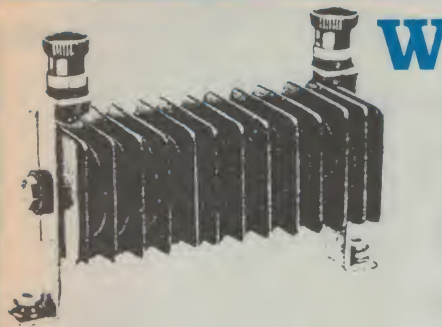
It is likely that the artists you have observed are quite experienced, and have a surprisingly high vocal output; consequently requiring less system gain.

Frequency shifters will make some difference, although most professional operators will not accept their performance compromises.

AM/FM Tuner

I read your January 'Forum' column with great interest, as I attempted to build the Playmaster AM/FM tuner project approximately 12 months ago. Previously I had successfully constructed the Playmaster 200 amplifier and have been exceptionally pleased with its performance, with the exception of the poor quality of the potentiometers supplied with the kit. This may possibly have boosted my confidence in the hobby to a level higher than my capabilities.

I purchased the tuner kit and answered my wife's doubts with 'of course



What was it?

Can you guess what this component was? It appeared on the Australian market in 1928. Similar devices were widely used, in one form or another until the 1960s. *(Answer next month)*

Answer for April

April's mystery item was an Elect-Tru-Tone electric pickup attachment, which converted an acoustic gramophone for electrical reproduction. The part on the right replaced the original 'sound box' on the gramophone arm, while the 4-pin plug on the left plugged into the detector valve socket of your radio (instead of the detector valve itself). According to the ads, it converted your gramophone into a 'beautiful electric reproducing machine, in a few seconds'.

it will work'. My skills and experience were sufficient to overcome an error in the layout of the copper tracks on the display PCB and to have the microprocessor section working. However, I am afraid to say that I could not get either the AM or FM sections to work. Despite considerable effort the problems were beyond me.

Having been a keen electronics enthusiast since a boy (I have bought every EA issue since 1969), and in this time built many of EA's projects – some successfully, some not – I accept responsibility for my failure to complete the tuner.

If you could publish my name and address, perhaps someone who has successfully built this project could write/-help me with mine. Failing this, someone may wish to purchase the complete kit from me.

I hope that the disgruntled reader who threatens *EA* with Consumer Affairs action does not precipitate the end of such projects, which offer enthusiasts a great many hours of pleasure. However, I think I will give tuners a miss in the future.

Stephen Pratten,
70 Marshall Street,
New Lambton Heights, 2305.

• ***Sorry you've had so much trouble with this project. As you can see, we've published your name and address as requested. If you still don't have any success, write in with details of the problems and we'll try to offer some suggestions.***

Telephone Adaptor

I wish to construct the 'Hands-free telephone adaptor' as described in your November 1985 edition. Can you advise where I could get the kit, or at least the printed circuit boards, as 'Technicraft Electronics' named in the article are no longer listed in the phone book. (L.G., Pascoe Vale, Vic.)

• ***The new address for Technicraft Electronics is 50 Webber Parade, East Keilor 3033. Phone (03) 336 7840. As Technicraft holds the copyright for the PC board used in this project, boards aren't available from other suppliers.***

NOTES & ERRATA

PLAYMASTER SERIES 200 MOSFET AMPLIFIER (Jan-May 1985): Some units may exhibit instability in the power amp stage, and in extreme cases overheat the 6.8 ohm 1W resistor in the output stability network. This should be cured by including a 100pF ceramic capacitor across the Base/Emitter pads of Q9.

Also, the situation may be aggravated by the wide bandwidth of IC4. This may be reduced by adding a 100pF ceramic across the 4.7k feedback resistor (between pins 2 and 6 of IC4).
(File: 1/SA/69-71)

UTILITY TIMER (March 1988): If the piezo buzzer 'beeps' normally, but the counter section refuses to count (LED1 remains on), this may be due to capacitor C5 having a rather higher value than its nominal 10uF. Trying another capacitor of the same nominal value may fix the problem, but in stubborn cases the value of resistor R4 may need to be reduced from its current value of 10k (to say 8.2k or 6.8k), to achieve reliable counting.

Note also with this project that LS1 must be a piezoelectric transducer, not a mini buzzer.
(File: 3/MS/135)

Interested in joining the staff of EA?

Australia's leading electronics magazine requires a project designer/writer for its editorial staff. This position involves the design and development of hobby electronics projects, and then writing about them for the magazine.

You'll need a sound knowledge of electronics theory and practice, and lots of **enthusiasm.** You'll also need to be able to express yourself clearly, in writing. But apart from that, we have no preconceived ideas about your background. You might be a student, a technician, a fully qualified engineer or just a keen enthusiast.

If you believe you're the person we're looking for, ring Jim Rowe on (02) 693 6620, or send your resume to him at Electronics Australia, Federal Publishing Company, 180 Bourke Road, Alexandria 2015.

50 and 25 years ago..

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

Wireless Weekly 3d

May 1938

Wireless Equipment Exported from Australia: Australian-made wireless equipment was shipped within the past few days to two new vessels under construction in the United Kingdom for the Australian trade.

The equipment was made by Amalgamated Wireless at the company's radio-electric works. For the Tambua, of the Colonial Sugar Refining Co., building at Dundee, AWA supplied a standard 500 watts transmitter and receiver, together with an auto alarm.

Radio Compass: First flight to New Guinea. The first aeroplane, VHUYV, fitted with combined radio compass and homing device to fly over the route between Sydney and New Guinea, has reached its destination at Salamaua. This plane is one of three similarly equipped for W.R. Carpenter and Co.

The radio compass employed is an Australian production of a type developed within the Amalgamated Wireless organisation. It can be used to determine the position of the plane, if, through fog, rain or lack of identifiable landmarks, the pilot is uncertain of his precise location. Alternately, it serves to keep the pilot directly on his course, the homing features of the appliance telling him instantly if he diverges to the right or left.

RADIO, TELEVISION and HOBBIES

May 1963

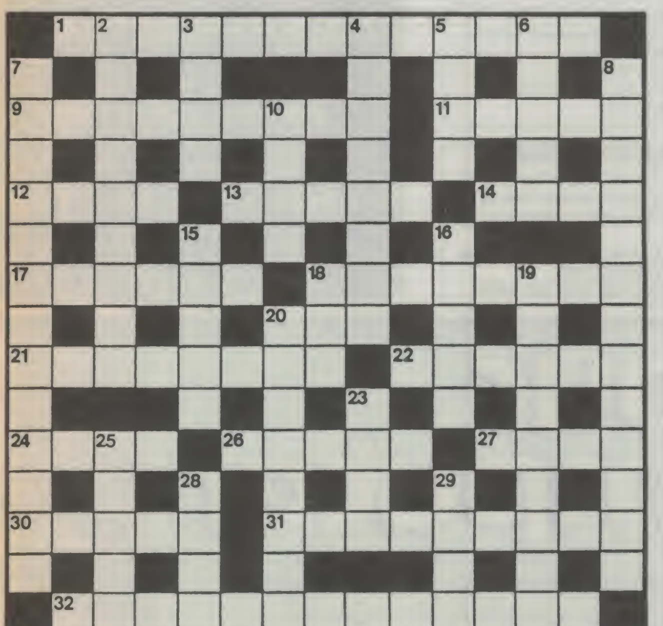
Glass Ignition Cables: Two American motor companies are using ignition cables made of glass which are said to reduce interference with wireless receivers in the cars.

Heart of the cables is a bundle of glass fibres coated with a conductive carbon. The cables are insulated with layers of glass fibre and rubber.

Television in the Dark: A new television system operates its 'cameras' in almost complete darkness. The light needed is no more than a millionth of a foot-candle, roughly equivalent to the light of a cloudly moonless night.

Flight tests in an aircraft have shown that observers using the new TV 'cameras' were able to see a road 25,000 feet away at a height of 2000 feet, three times the distance at which the unaided eye could identify the road. A man standing beside a car could be seen, with the system, 2000 feet away.

MAY CROSSWORD



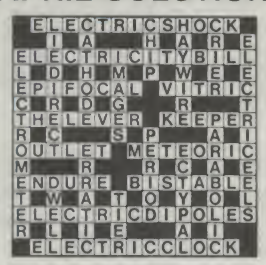
ACROSS

1. A discharge. (8,5)
9. Atmospheric phenomenon that's potentially dangerous. (9)
11. Proprietary name of European origin. (5)
12. ATM activator. (4)
13. Insects that fly around the globe. (5)
14. Piece of equipment. (4)
17. Light-sensitive surface with electrical output in head. (6)
18. Communication system for ships. (8)
20. Diode-transistor logic. (1,1,1)
21. Such are the 1988 days of 20 down. (8)
22. Speaker's cover. (6)
24. Possible state of a circuit. (4)
26. Type of diode. (5)
27. What 32 across has to do to get a potential drop! (4)
30. Spot's image on the tube. (5)
31. Physicist famous for formulating a fluid flow principle. (9)
32. Serviceman's device for upkeep of your Commodore? (8,5)

DOWN

2. Power of a base. (9)
3. Edits. (4)
4. Sprockets for feeding punched paper. (8)
5. Private telephone exchange. (1,1,1,1)
6. Synthetic insulating substance. (5)
7. Energy units. (8–5)
8. Kind of cell activated by light. (13)
10. Symbol displayed on user-friendly screens. (4)
15. Get access to computer. (5)
16. Top spot for a conductor of 9 across. (5)
18. Trunk telephone system. (1,1,1)
19. Regions with energy wells? Or black holes? (9)
20. Month, historically converted from metric to imperial. (8)
23. It transmits motion! (4)
25. This firm's business was intially limited to electricity meters and allied industries. (5)
28. Brand of hifi equipment. (4)
29. Term used to denote non-stereo. (4)

APRIL SOLUTION



EA marketplace EA marketplace

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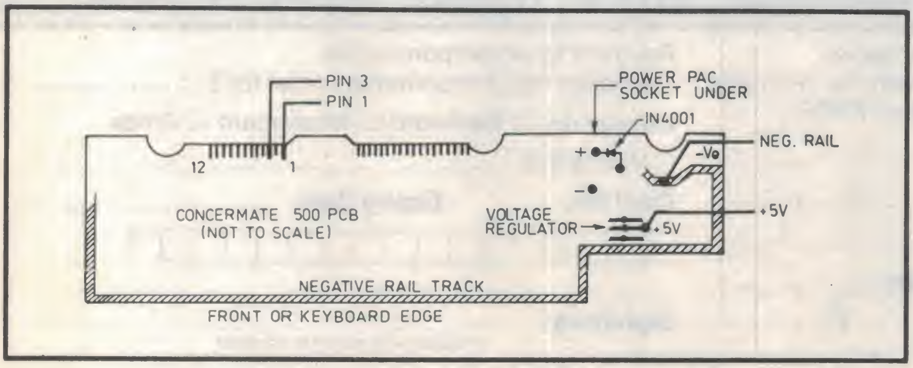
Circuit & Design Ideas

Continued from page 93



As both the front power switch and the internal shutdown circuit break the negative rail, it is important to take the negative supply for the add-on from the correct place. This is the outer track on the front edge of the PCB, which is most easily connected to, where shown.

The 5 volt positive supply comes from the centre pin of the voltage regulator transistor. Before working on the PCB remember to earth both the soldering iron and the board to avoid problems from static charges.

The relevant points on the PCB were connected to a 5 pin DIN socket mounted at the back by the speaker and the add on circuitry, housed in a small plastic box, plugged in. The Concertmate 500 now retains whatever program material is stored in memory, indefinitely.

Mr W.A. Jolly,
Nambucca Heads, NSW.

$50

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